

PHILIPPINE ZOOLOGICAL EXPEDITION

1946-1947

THE PHILIPPINE BITING MIDGES
OF THE GENUS CULICOIDES
(DIPTERA: CERATOPOGONIDAE)

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FIELDIANA: ZOOLOGY

VOLUME 33, NUMBER 7

Published by

CHICAGO NATURAL HISTORY MUSEUM

JULY 25, 1961

Edited by LILLIAN A. ROSS

Library of Congress Catalog Card Number: 61-11184

PRINTED IN THE UNITED STATES OF AMERICA
BY CHICAGO NATURAL HISTORY MUSEUM PRESS

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CONTENTS

	PAGE
LIST OF PLATES	631
INTRODUCTION	633
METHODS AND TERMINOLOGY	634
SYSTEMATIC TREATMENT	636
Genus <i>Culicoides</i> Latreille	636
Key to species	636
Subgenus <i>Monoculicoides</i> Khalaf	640
<i>Oecacta</i> Poey	641
<i>Avaritia</i> Fox	653
<i>Hoffmania</i> Fox	658
<i>Culicoides</i> Latreille	660
<i>Trithecoides</i> Wirth and Hubert	666
ACKNOWLEDGEMENTS	669
REFERENCES	670

LIST OF PLATES

- | | |
|---|---|
| 8-10. Wings of <i>Culicoides</i> . | 12. Eyes of female <i>Culicoides</i> . |
| 11. Palps of <i>Culicoides</i> . | 13. Spermathecae of <i>Culicoides</i> . |
| 14. Male genitalia of <i>Culicoides</i> . | |

The Philippine Expedition: *Culicoides* (Diptera)¹

INTRODUCTION

The blood-sucking flies of the genus *Culicoides* affect man by their severe and irritating bites (Arean and Fox, 1955; Hase, 1953), and by transmitting human and animal diseases (Hopkins and Nicholas, 1952; Henrard and Peel, 1949; Romana and Wygodzinsky, 1950; Price and Hardy, 1954; and others).

The first record of the genus *Culicoides* in the Philippines was published by Bezzi (1917), who briefly described *C. judicandus*. This was followed by a paper by Kieffer (1921), who included the description of *C. philippinensis*. Edwards (1929) listed the occurrence of *C. oxystoma* Kieffer, *C. gymnopterus* Edwards, and *C. pungens* de Meijere, and considered *C. judicandus* the same as *C. philippinensis*. Both Bezzi's and Kieffer's species are now regarded as synonyms of *Culicoides peregrinus* Kieffer by Macfie (1937), and *C. oxystoma* is considered a synonym of *C. schultzei* (Enderlein) by Wirth (personal communication). Recently, Wirth and Hubert (1959) added seven species from this region. These are: *C. albibasis* Wirth and Hubert, *C. baisasi* Wirth and Hubert, *C. barnetti* Wirth and Hubert, *C. flavescens* Macfie, *C. flaviscutatus* Wirth and Hubert, *C. palpifer* das Gupta and Gosh, and *C. sarawakensis* Wirth and Hubert.

This study has revealed an additional 35 species in this area, bringing the total to 46 species known from the Philippines. Of the 46 species, 21 are described as new, 14 are new Philippine records, and 11 were previously reported.

As this paper is a synopsis for the identification of Philippine *Culicoides*, only descriptions and brief comparisons are made. Discussions of the interrelations among the species and species groups of the genus have been omitted. However, the species are divided into taxonomic groups, and the appropriate subgeneric names have been utilized. A brief definition is given for each subgenus.

¹ A thesis presented to the Faculty of the Graduate School of Cornell University for the Degree of Master of Science, February, 1960.

It is hoped that this paper will form a basis for the accurate identification of Philippine *Culicoides* and will promote further study of the new forms that await discovery.

METHODS AND TERMINOLOGY

The specimens studied are based upon material obtained by the Chicago Natural History Museum Philippine Zoological Expedition (1946-47),¹ and upon the collection of the Division of Malaria, Philippine Department of Health, all collected from carabao-baited traps and light traps designed for mosquito collection.

The types of the new species are deposited either in the collections of Chicago Natural History Museum or in the Division of Malaria, Philippine Department of Health, Manila, as indicated below.

Paratypes are deposited in the collections of Chicago Natural History Museum (CNHM); Division of Malaria, Philippine Department of Health (PDH); Bernice P. Bishop Museum, Honolulu (BPBM); British Museum (Natural History) (BMNH); and the United States National Museum (USNM).

Specimens of previously described species have also been distributed among these collections, but the depositories for these are not indicated. The italicized abbreviation *CNHM* followed by a number, e.g., *CNHM-15*, is the lot number of the specimens which it follows and does not indicate the depository.

To obtain measurements of the body, wing, and female spermathecae, to procure antennal and palpal proportions, and for purposes of illustrations, specimens were cleared and mounted on microscope slides. The phenol-balsam method of Wirth (1952) was used for most of the specimens. In some cases, mounted specimens have been prepared by this method: Dried specimens are relaxed in liquid phenol, the wings are removed, and the head and body are placed in 5 per cent KOH solution. If specimens are fresh or preserved in alcohol, the wings are removed and then transferred to phenol; the head and body are placed in KOH. The parts in the KOH solution are gently heated until clear, then washed in acidified distilled water and dehydrated through several grades of alcohol (50-70-80-90 per cent). The specimens are mounted in balsam or diaphane.

¹[The Ceratopogonidae collected by members of the Philippine Zoological Expedition included 26 species of the genus *Culicoides*, of which 17 were new. Of these 9 are known and described solely from the specimens collected by the expedition. In addition, a new genus has previously been described from this collection by Wirth and Hubert (1960).—EDITOR.]

The terminology adopted in this study is that of Wirth (1952) and Wirth and Blanton (1953, 1956a). All measurements are made from slide-mounted specimens. The measurements are made with an ocular micrometer disc and are converted to microns or millimeter equivalents. Measurements for each species are usually based on a single specimen. When more than one specimen is involved, the measurements are presented as follows: "mean (minimum-maximum, n =number of measurements)." Body length is measured from the anterior edge of the mesonotum to the tip of the abdomen. Wing length is measured from the basal arculus to the wing tip. The female antennal ratio is obtained by dividing the combined lengths of the last five segments by the combined lengths of the preceding eight. The presence of antennal sensoria or distal sensory tufts is indicated by Roman numerals on specific antennal segments.

Tillyard's (1926) modification of the Comstock-Needham (1898-99) system of wing venation and cell designation is used here. Thus, veins Cu_1 and Cu_2 of Comstock-Needham, Hoffman (1925), Foote and Pratt (1954), and Forattini (1957) become M_{3+4} and Cu_1 , respectively, and cell Cu_1 becomes cell M_4 .

In addition to the basic characters of wing pattern, of the male genitalia, and of the number of the female spermathecae used for the identification of species, certain quantitative characters of the females such as those discussed by Wirth and Blanton (1953, 1956a, 1956b) have also been utilized: the wing length; the costal length; the relative lengths of the flagellar segments of the antenna; the antennal ratio; the number of antennal segments bearing the distal sensoria; the number of teeth on the mandible; the number of spines in the comb at the apex of the hind tibia; and the relative size and proportions of each of the spermathecae.

It was found in this study that certain characters of the sucking apparatus, particularly the small spines or papillae on the epipharyngeal wall of the cibarial pump, and the ventral teeth at the mouth entrance, have taxonomic value. These characters are clearly seen in *Culicoides pampangensis*, new sp., *C. arakawai* (Arakawa) and *C. guttifer* de Meijere.

The descriptions of the species are based on slide-mounted specimens and do not include the mesonotal pattern. The illustrations have been made from slide preparations by using a microprojector.

SYSTEMATIC TREATMENT

Genus *CULICOIDES* Latreille

Culicoides Latreille, 1809, Gen Crust. et Ins., 4: 251.

Type of the genus: *Culicoides punctata* Latreille, monobasic.

Wirth (1952) and Wirth and Blanton (1959) provide an extensive bibliography, synonymy and morphology of the genus. Diagnosis:

Small flies 1–2.5 mm. long, with moderately slender, lightly hairy body. Head with eyes usually bare, rarely hairy between facets, contiguous or separate; antennae 15-segmented with basal segment or scape ring-like, distal sensory tufts or sensoria present on most segments; female antennae with segments 3–10 rounded, oval or elongate but never shorter than individual segments 11–15; male antennae plumose, the last 3 segments elongate. Mesonotum with or without pattern, hairs and bristles short; humeral pits always large and distinct; scutellum with mid-scutellar and lateral bristles. Legs slender; femora sometimes slightly swollen, without spines; hind tibia with two transverse rows of spines and an anterior spur distally; claws small, usually simple, equal in both sexes; empodium shorter than claw length. Wing with pattern of pale and dark spots or bands, dense microtrichia, macrotrichia usually present, 1–2 anterior radial cells, usually 2, of sub-equal lengths; crossvein *r-m* slightly oblique; median fork distinctly petiolate. 1–3 well-developed spermathecae; rudimentary spermatheca and ring present or absent. Male terminalia with ninth sternite short, the posterior margin emarginate; ninth tergite with or without apicolateral processes; basistyle enlarged at base with developed or undeveloped dorsal and ventral roots; dististyle slightly swollen at base, slender distally with an incurved point; aedeagus usually an inverted Y-shape with sclerotized basal arms or arch and stem directed ventro-caudad; parameres sclerotized, with knobbed bases and ventrally directed distal points.

KEY TO FEMALES OF PHILIPPINE SPECIES OF *CULICOIDES*¹

1. Wing with the second radial cell included in a pale spot at apex.....2
Wing with the second radial cell entirely dark, or tip may appear pale where end of vein R_{4+5} is included in a pale spot.....19
2. With two well-developed spermathecae.....3
With three well-developed spermathecae (subgenus *Trithecoides*).....37
3. Base of cell M_4 dark bordering veins M_{3+4} and Cu_14
Base of cell M_4 pale bordering veins M_{3+4} and Cu_1 at the base of fork, apices of veins M_1 , M_2 and M_{3+4} usually pale (subgenus *Hoffmania*).....16
4. Anterior radial cells not separated, the single radial cell long and narrow extending through pale spot to third dark costal spot; third palpal segment without sensory pit but with a few scattered sensoria (subgenus *Culicoides*, in part).....5
Anterior radial cells distinctly separate, the second usually ending in a pale spot a considerable distance from third dark spot; third palpal segment swollen and with common sensory pit.....6
5. Cell R_5 with pale spot broadly meeting anterior margin of wing; prominent, narrow, transverse dark band across wing; legs unbanded.
unicus, new sp., p. 665

¹ Females of *C. gymnopterus*, *C. malayae*, and *C. sumatrae* unknown.

- Cell R_5 with pale spot widely separated from margin of wing; diffuse dark band across wing, the first and second bands interrupted at middle of cell M_1 ; bases of all tibiae yellowish; wing 1.27 mm. long (pl. 10, fig. 3).
gemellus Macfie, p. 661
6. Pale spot anterior to mediocubital fork absent, cell M_2 usually pale from base to apex; large distal pale spot broadly attaining margin of wing; third palpal segment small and not narrowed beyond pit; small to large species; wing 0.70–1.03 mm. long (subgenus *Avaritia*) 7
Pale spot in cell M_2 anterior to mediocubital fork always present; distal pale spot on cell R_5 smaller, may or may not reach anterior margin of wing; third palpal segment usually elongate and narrowed distally; larger species; wing 0.91–1.03 mm. long (subgenus *Culicoides*) 14
7. Wing appearing brownish with pale markings indistinct; halter brown; antennal sensoria present on segments III, XI–XV; wing 0.82 mm. long (pl. 9, fig. 11) *pungens* de Meijere, p. 656
Wing with pale areas extensive, more or less prominent 8
8. Eyes hairy between facets; antennal sensoria present on segments III, XII–XV; radial cells short and small, only the tip included in pale spot; halter yellowish-white; wing 0.84 mm. long (pl. 9, fig. 5) *actoni* Smith, p. 654
Eyes bare; antennal sensoria present on segments III, XI–XV; radial cells longer, usually distal half of second radial cell pale 9
9. Third palpal segment without sensory pit but with scattered, hyaline sensoria forming a rounded pitted spot; halter whitish *nudipalpis*, new sp., p. 655
Third palpal segment with distinct sensory pit 10
10. Anal cell with dark streak which may be interrupted before posterior margin of wing 11
Anal cell with two rounded dark spots, base broadly pale 12
11. Front and middle knees of tibiae and femora pale, base of hind tibia yellowish; mediocubital fork pale-margined along veins M_{3+4} and Cu_1 ; wing 1.03 mm. long (pl. 9, fig. 7) *boophagus* Macfie, p. 655
Front and middle knees dark with adjacent pale band on tibiae and femora, base and apex of hind tibia pale 13
12. Base of vein M_2 pale at medial fork, apex dark; legs unbanded, knees of femora and tibiae pale *brevipalpis*, new sp., p. 654
Base of vein M_2 dark at medial fork, apex pale; legs banded, knees dark with adjacent pale band on front and middle femora and tibiae.
radicitus, new sp., p. 657
13. Dark streak on anal cell continuous, distal pale spot on cell R_5 broadly meeting margin of wing; antennal sensoria present on segments III, XI–XV; wing 0.88 mm. long (pl. 9, fig. 10) *orientalis* Macfie, p. 656
Dark streak interrupted, distal pale spot on cell R_5 not reaching margin of wing; antennal sensoria present on segments III, XI–XIV; wing 0.70 mm. long (pl. 9, fig. 8) *jacobsoni* Macfie, p. 655
- 14(6). Eyes contiguous; pale spot over crossvein $r-m$ may or may not be separated anteriorly from costal pale spot *assimilis*, new sp., p. 660
Eyes widely separated; pale spot over crossvein $r-m$ usually separated anteriorly from costal pale spot 15
15. Vein R_{4+5} dark into adjacent pale area up to where vein turns abruptly forward to meet costa *recurvus*, new sp., p. 663
Vein R_{4+5} not dark to where vein turns forward to meet costa.
hirtipennis, new sp., p. 662
- 16(3). Pale wing markings extensive, almost all of second radial cell included in a large pale spot, limiting the transverse costal dark spots; third palpal segment without sensory pit but scattered sensoria *effusus*, new sp., p. 658
Pale markings less extensive, costal dark spots broad 17
17. Crossvein $r-m$ entirely pale, costa ending in a pale spot a considerable distance from third dark area 18

- Crossvein *r-m* dark, separating the pale spot before and after it, costa extending through pale spot with tip touching third dark area; wing 1.05 mm. long (pl. 9, fig. 15).....*insignipennis* Macfie, p. 659
18. Third dark costal spot broad, distal pale spot on cell R_5 narrow and transverse, apices of veins M_1 , M_2 and M_{3+4} pale; eyes just touching; third palpal segment with divided sensory pits; wing 1.10 mm. long (pl. 10, fig. 1).....*peregrinus* Kieffer, p. 660
- Third dark costal spot narrowed by two large pale spots on cell R_5 ; only tip of vein M_1 pale; eyes contiguous for the length of the diameter of 2.5 facets; third palpal segment with a moderately large sensory pit.
bulbalus, new sp., p. 658
- 19(1). With two well-developed spermathecae (subgenus *Oecacta*).....20
With only one large spermatheca (subgenus *Monoculicoides*).....35
20. Extreme tip of second radial cell pale where end of vein R_{4+5} is included in a pale spot.....21
Second radial cell entirely dark.....24
21. Wing with anterior radial cells not separated.....*longipalpis*, new sp., p. 645
Wing with two anterior radial cells.....22
22. Two distinct spots present, other pale areas absent...*wenzeli*, new sp., p. 649
Wing not as above.....23
23. With pale spots forming two broad transverse bands across wing, pale areas in apices of cells M_1 , M_2 and R_5 barely discernible.
pampangensis, new sp., p. 650
- Pale markings extensive, not forming transverse bands across wing, apical cells with large pale spots.....*ejercitoi*, new sp., p. 643
24. Cell R_5 with pale spots immediately posterior to pale spot just beyond end of second radial cell, or anterior to mediocubital fork; antennal sensoria present on segments III, VII-X, never exceeding segment X.....25
Pale spots anterior to vein M_1 and mediocubital fork absent; antennal sensoria variable on segments III, XIV, or III, XI-XIV.....29
25. Crossvein *r-m* and first radial cell more or less dark, not included in a pale spot in front of crossvein; cell R_5 with small pale spot at wing tip separate from margin of wing.....26
Crossvein *r-m* with pale spot reaching anterior margin of wing; large distal pale spot on cell R_5 broadly open anteriorly, various shapes.....27
26. Antennal sensoria present on segments III, VII-X; front knee with adjacent pale band on tibia; wing 0.71 mm. long.....*claripalpis* Mukerji, p. 641
Antennal sensoria present on segments III, V, VII-X; knees dark with adjacent pale band on front and middle femora and all tibiae; wing 0.84 mm. long (pl. 8, fig. 8).....*huffi* Causey, p. 644
27. Cell R_5 with two pale spots immediately posterior to pale spot just beyond end of second radial cell.....28
Cell R_5 with only one pale spot posterior to pale spot just beyond end of second radial cell, and a subtriangular spot at tip along margin of wing; antennal sensoria present on segments III, VII-X...*notatus*, new sp., p. 648
28. Distal pale spot on cell R_5 hourglass-shaped; eyes widely separated; antennal sensoria present on segments III, VII-X; wing 0.82 mm. long (pl. 9, fig. 4).
schantzei (Enderlein), p. 653
Distal pale spot on cell R_5 irregular in shape, nearly filling distal half of cell, more or less U-shaped and broadly emarginate anteriorly; eyes contiguous for the length of 3.5 facets.....*perornatus*, new sp., p. 651
29. Distal pale spot on cell R_5 large, nearly filling half of cell and broadly meeting margin of wing; pale spot past tip of second radial cell diffuse; antennal sensoria usually present on segments III-XIV (except in *cordiger* Macfie, in which they are present on segments III-XV).....30

- Distal pale spot on cell R_5 small and well separated from margin of wing, or may be at wing tip; two pale spots past tip of second radial cell may or may not be connected; antennal sensoria variable, present from segments III–XIV, and III, XI–XIV. 31
30. Antennal sensoria present on segments III–XV; fourth tarsal segment cordate; wing 1.22 mm. long (pl. 8, fig. 5) *cordiger* Macfie, p. 642
Antennal sensoria present on segments III–XIV; fourth tarsal segment elongate. 32
31. Small distal pale spot on cell R_5 at wing tip; macrotrichia long and abundant over most of wing surface; antennal sensoria present on segments III, XI–XIV. *marginatus*, new sp., p. 646
Large distal pale spots on cell R_5 not reaching margin of wing; macrotrichia sparse, confined to distal half of wing or apices of wing. 33
32. Legs banded, with dark brown knees; antennal ratio 1.21; third palpal segment 2.06 times as long as broad. *mcdownelli*, new sp., p. 647
Legs entirely brown, unbanded; antennal ratio 1.53; third palpal segment 2.34 times as long as its greatest breadth. *palawanensis*, new sp., p. 648
33. Knees not dark, base of hind tibia pale; antennal sensoria variable on segments III–XIV and III–IX, XI–XIV. *damnosus*, new sp., p. 642
Knees dark with adjacent pale band on tibiae. 34
34. Antennal sensoria present on segments III–XIV; antennal ratio 1.37; apices of cells R_5 and M_1 each with additional small pale spots along margin of wing. *praesignis*, new sp., p. 652
Antennal sensoria present on segments III–X, XIII–XIV; antennal ratio 1.14; pale spots on apices of cells R_5 and M_1 absent. *infulatus*, new sp., p. 644
- 35(19). Cell R_5 with one large pale spot past tip of second radial cell; macrotrichia sparse; spermatheca ovoid, thinly sclerotized; antennal sensoria present on segments III, XI–XIV; wing 0.89 mm. long (pl. 8, fig. 3). *hegneri* Causey, p. 641
Cell R_5 with two pale spots just beyond tip of second radial cell, the second partly underlying the cell; macrotrichia abundant. 36
36. With an additional rounded pale spot anterior to base of medial fork; spermatheca elongate oval; antennal sensoria present on segments III, IV, XI–XIV; wing 0.93 mm. long (pl. 8, fig. 2). *guttifer* de Meijere, p. 640
Without such a spot; spermatheca pyriform with wide opening to duct; antennal sensoria present on segments III–XIV; wing 1.12 mm. long (pl. 8, fig. 1). *arakawai* (Arakawa), p. 640
- 37(2). Spermathecae subequal and pyriform with short sclerotized necks, small openings to ducts; wing largely pale with two prominent dark spots on anterior margin; hind femur narrowly dark at apex; mandible teeth 15–16; wing 1.03 mm. long (pl. 10, fig. 13). *flavescens* Macfie, p. 667
Spermathecae unequal, rounded or elongate oval, sclerotized neck absent, openings to ducts large; mandible teeth 7–13. 38
38. Mandible teeth 7–8, the distal ones largest; halter knob pale; wing tip with pale narrow band; spermathecae rounded. 39
Mandible teeth 10–13, the distal ones scarcely larger than proximal series; spermathecae oval, the larger ones sometimes elongate. 40
39. Mandible with 7 curved teeth; hind femur dark, sometimes with narrow pale subapical band; wing with only distal half of second radial cell included in a pale spot; wing 0.98 mm. long (pl. 10, fig. 15). *palpifer* das Gupta and Gosh, p. 668
Mandible with 8 triangular teeth; hind femur with distinct pale subapical band; nearly all of second radial cell in a pale spot; wing 0.82 mm. long (pl. 10, fig. 11). *baisasi* Wirth and Hubert, p. 666
40. Wing tip with pale band; halter knob pale; mandible teeth 10–12. 41
Wing tip without pale band; halter knob dark; mandible teeth 10–13. 42

41. Hind femur dark, unbanded; wing appearing brownish with diffuse posterior pale spots; mandible teeth 10-13; wing 1.33 mm. long (pl. 10, fig. 14).
flaviscutatus Wirth and Hubert, p. 667
 Hind femur with subapical pale band; pale wing markings prominent with broad pale apical band; mandible teeth 12; wing 1.05 mm. long (pl. 10, fig. 12).....*barnetti* Wirth and Hubert, p. 667
42. Hind femur dark, unbanded; mandible teeth 13; wing brownish with diffuse posterior pale spots; wing 0.92 mm. long.
sarawakensis Wirth and Hubert, p. 668
 Hind femur pale to knee; wing largely pale on basal half; mandible teeth 10-11; wing 0.89 mm. long.....*albibasis* Wirth and Hubert, p. 666

Subgenus *Monoculicoides* Khalaf

Monoculicoides Khalaf, 1954, Ann. Ent. Soc. Amer., 47: 46.

Type of the subgenus: *Culicoides nubeculosus* (Meigen), by original designation.

Species having only one large spermatheca; second radial cell entirely dark; wing with prominent pattern; male aedeagus massive; basistyle of ventral and dorsal roots developed; ninth tergum with apicolateral processes present.

Included species: *arakawai*, *guttifer*, *hegneri*.

Culicoides (*Monoculicoides*) *arakawai* (Arakawa)

Ceratopogon arakanae Arakawa, 1910, Konchu-Sekai, 14: 411 (*arakanae* is a misprint of *arakawae*); Matsumura, 1915, Konchu Bunrui Gaku Gekan, p. 56.

Culicoides arakawae (Arakawa), Arnaud, 1956, Microent., 21: 92 (redescr. female, male; Japan; eyes, antennae, palp, mouth-parts, scutum, legs, wings, male genitalia, and spermatheca illus.).

Culicoides arakawai (Arakawa), Sen and das Gupta, 1959, Ann. Ent. Soc. Amer., 52, (5), p. 624.

Diagnostic characters.—Wing with second radial cell entirely dark, cell R_5 with 3 subequal, rounded pale spots, the first just past tip of second radial cell, the second partly underlying cell, and the third at apex of cell along margin of wing (pl. 8, fig. 1); eyes widely separated; antenna with distal sensory tufts present on segments III-XIV; third palpal segment swollen, with large sensory pit; one spermatheca large, elongate pyriform, well sclerotized; male aedeagus massive, with broad truncated tip; ninth tergum with developed apicolateral processes; parameres stout, simple; dorsal and ventral roots of basistyle developed.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat; Tala, Rizal, May 21, 1958, light trap, M. D. Delfinado.

Culicoides (*Monoculicoides*) *guttifer* de Meijere

Culicoides guttifer de Meijere, 1907, Tijdschr. Ent., 50: 209 (female; Java; wing illus.).

Diagnostic characters.—Wing with dark spot over second radial cell and most of first radial cell; cell R_5 with 4 pale spots, the first just past tip of second radial cell, the second partly underlying the cell, the third located anterior to base of medial fork, and the fourth at apex along margin of wing (pl. 8, fig. 2); eyes narrowly separated; antenna with distal sensory tufts present on segments III–IV, XI–XIV; third palpal segment swollen, with large sensory pit near apex; front and middle legs with subapical pale band on femur and sub-basal pale band on tibia; hind tibial comb with 4 spines; one spermatheca large, elongate-oval.

Distribution.—Luzon: Tala, Rizal, May 22, 1958, light trap, M. D. Delfinado.

Culicoides (Monoculicoides) hegneri Causey

Culicoides hegneri Causey, 1938, Amer. Jour. Hyg., 27 (2), p. 402 (male, female; Siam, at light; spermatheca, wing, and male hypopygium illus.).

Diagnostic characters.—Wing with second radial cell entirely dark, pale markings more or less extensive, cell R_5 with two large pale spots, one past tip of second radial cell and the second at apex of cell R_5 , radial cells large and broad (pl. 8, fig. 3); eyes widely separated; antenna with distal sensory tufts present on segments III, XI–XIV; third palpal segment moderately enlarged, with small sensory pit; one spermatheca large, ovoid and thinly sclerotized.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat. Tala, Rizal, May 21, 1958, light trap, M. D. Delfinado.—Mindanao: Pikit, Cotabato, December 16, 1946, at light, F. G. Werner.

Subgenus Oecacta Poey

Oecacta Poey, 1851, Mem. Hist. Nat. Isla Cuba, 1: 236.

Type of the subgenus: *Oecacta furens* Poey, monobasic.

Species having two well-developed spermathecae; second radial cell usually dark; wing with prominent pattern; hind tibial comb with four spines; male genitalia with well-developed apicolateral processes; dorsal and ventral roots of basistyle usually developed; parameres separated or joined at bases.

Included species: *clavipalpis*, *cordiger*, *damnosus*, *ejercitoi*, *huffi*, *infulatus*, *longipalpis*, *marginatus*, *mcdowelli*, *notatus*, *palawanensis*, *wenzeli*, *pampangensis*, *perornatus*, *praesignis*, *schultzei*.

Culicoides (Oecacta) clavipalpis Mukerji

Culicoides clavipalpis Mukerji, 1931, Indian Jour. Med. Res., 18: 1052 (female; India; antenna, head, wing, fore and hind legs, spermathecae, and eighth abdominal sternite illus.).

Diagnostic characters.—Wing with radial cells and crossvein $r-m$ dark, pale spot past tip of second radial cell angular, extending posteriorly to vein M_1 (pl. 8, fig. 4); eyes contiguous; antenna with distal sensory tufts present on segments III,

VII-X; third palpal segment greatly swollen, with large deep sensory pit; hind tibial comb with four widely spaced spines; two well-sclerotized spermathecae with long neck; male aedeagus with spines at basal arch, serrated tip; parameres with strongly serrated tip, large thumblike projection; dorsal and ventral roots of basistyle well developed; ninth tergum with long, tapering, apicolateral processes.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat.

Culicoides (Oecacta) cordiger Macfie

Culicoides cordiger Macfie, 1934, Ann. Trop. Med. Parasit., 28 (2), p. 193 (female; Malaya; wing illus.).

Diagnostic characters.—Wing with second radial cell and distal half of first cell blackish, a small blackish rounded spot at middle of cell R_5 between two large pale spots, one just past tip of second radial cell and the other at apex of cell along margin of wing, basal half of cell M_2 largely pale (pl. 8, fig. 5); eyes very narrowly separated; antenna with distal sensory tufts present on segments III–XV; third palpal segment greatly enlarged, with a large, deep sensory pit; fourth tarsal segment of all legs cordiform; hind tibial comb with four spines; two moderately large spermathecae.

Distribution.—Canacan, Aborlan, and Puerto Princesa, Palawan, April–May 17, 1947, H. Hoogstraal and F. G. Werner.

Culicoides (Oecacta) damnosus, new species

By wing pattern, *damnosus* appears to be related to *praesignis*, but its variable antennal sensorial pattern (segments III–XIV, and III–IX, XI–XIV) and pale knees do not resemble those of *praesignis*.

Female.—Length about 1.4 mm., wing 0.91 (0.86–0.98, $n=10$) mm. long. Eyes widely separated above, narrowing posteriorly (pl. 12, fig. 1). Antenna with flagellar segments in proportion of 40:27:27:27:27:27:27:27:54:51:61:61:81, antennal ratio 1.35 (1.29–1.40, $n=6$); antennal sensoria present on segments III–IX, XI–XIV, and III–XIV. Palpal segments in proportion of 20:47:54:23:27; third segment (pl. 11, fig. 1) distinctly swollen, 1.95 (1.87–2.00, $n=6$) times as long as broad with a large, deep, sensory pit on distal half. Mandible teeth 12 (11–14, $n=9$). Legs brown; knee spot absent; hind tibia with narrow, pale, basal band, four spines on comb. Wing (pl. 8, fig. 6) with costa extending 0.56 (0.53–0.60, $n=10$) of wing length; macrotrichia long and abundant on distal half of wing and arranged in rows on cells M_1 and M_2 ; very few on apex of anal cell. Wing predominantly brown with blackish spot over second radial cell and distal half of first, limited pale areas as shown in figure. Small, rounded, pale spots, one over cross-vein $r-m$, one past tip of second radial cell, and just below it a paler one which may or may not be connected; in paler specimens this spot is barely discernible; distal pale spot in cell R_5 broadly separated from margin of wing; cell M_1 with rounded basal and submarginal pale spots; diffuse lighter spots on cell M_2 , one behind medial fork, and one at tip of cell along margin of wing; distinct rounded

pale spots at apex of cell M_4 , and on anal cell just behind mediocubital fork. Halter brown. Spermathecae (pl. 13, fig. 1) two, subspherical, equal, each measuring 0.040 by 0.051 mm.; only rudimentary spermatheca present, ring absent.

Male.—Unknown.

Holotype.—A female, CNHM-17, Bacungan, Puerto Princesa, Palawan, March 27, 1947, "biting man," F. G. Werner. In the collection of Chicago Natural History Museum.

Paratypes.—Six females, same data as holotype (2, USNM; 2, PDH; 2, CNHM); 7 females, Puerto Princesa, Palawan, August 24, 1925, "biting man," R. C. McGregor (1, PDH; 1, BMNH; 1, BPBM; 4, USNM).

Plesiotype.—A female, same data as holotype (CNHM).

Culicoides (Oecacta) ejercitoi, new species

Except for the difference in the extent of the pale spot at the tip of the second radial cell, and the structure of the sensory pit on the third palpal segment, this species seems to be identical with *peliliowensis* Tokunaga.

Female.—Length about 1.16 mm., wing 1.02 (0.99–1.09, $n=4$) mm. long. Eyes narrowly separated (pl. 12, fig. 2). Antenna with flagellar segments in proportion of 37:27:27:27:27:27:27:47:47:51:51:64, antennal ratio 1.13 (1.10–1.16, $n=4$); antennal sensoria present on segments III–XIV. Palpal segments in proportion of 17:47:61:27:30; third segment (pl. 11, fig. 2) greatly swollen, 2.45 (2.25–2.65, $n=4$) times as long as its greatest breadth, with large, irregular, sensory pit and narrow apex. Mandible with 13 (13–15, $n=4$) teeth. Legs brown with narrow dark knees, slightly distinct pale sub-basal band on front and hind tibiae; mid-knee pale at femur and tibia; hind tibial comb with 4 spines. Wing (pl. 8, fig. 9) with costa extending 0.65 (0.61–0.70, $n=4$) of wing length; macrotrichia long and abundant over most of wing surface. Wing pattern as figured; pale markings extensive, second radial cell paler toward tip but not distinctly included in a large pale spot on cell R_5 ; a large pale spot on cell R_5 nearly filling distal half of cell and broadly meeting margin of wing, and a spot on apices of cells M_1 and M_2 , the one on cell M_1 indistinctly separated from margin of wing the other meeting it; cell M_2 extensively pale from base of cell to level of large basal pale spot on cell M_1 ; a large distal pale spot filling half of cell M_4 ; anal cell pale at basal third and with a large double spot behind mediocubital fork to posterior margin of wing. Two narrow, transverse, dark bands across wing, each interrupted at middle of cell M_2 before mediocubital vein and continuing from this vein across middle of anal cell and from mediocubital fork to tip of vein Cu_1 ; a third dark band zigzag, from middle of cell R_5 anteriorly to tip of vein M_{3+4} ; a small, rounded dark spot straddling base of mediocubital vein just past arculus. Halter pale. Spermathecae (pl. 13, fig. 2) two, unequal, pyriform, measuring 0.040 by 0.051 and 0.037 by 0.061 mm.; rudimentary spermatheca and ring both present.

Male.—Unknown.

Holotype.—A female, *CNHM-12*, Siuk, Calamianes, Culion Island, Palawan, April 7, 1947, "Z. C.," near sea level. In the collection of Chicago Natural History Museum.

Paratypes.—Two females, *CNHM-12*, Dimanianga, Busuanga Island, Palawan, March, 1947, near sea level, H. Hoogstraal (1, USNM; 1, PDH); 1 female, *CNHM-16*, Maco, Tagum, Davao, October, 1946, near sea level, H. Hoogstraal and D. Heyneman (CNHM).

Remarks.—This species is named in memory of Dr. Antonio Ejercito, of the Department of Health, Manila, Philippines, in recognition of his outstanding contribution to malaria control.

Culicoides (Oecacta) huffi Causey

Culicoides huffi Causey, 1938, Amer. Jour. Hyg., 27 (2), p. 406 (male, female; Siam, at light; spermathecae, wing, and male hypopygium illus.).

Diagnostic characters.—Wing with second radial cell dark, crossvein *r-m* and first radial cell more or less dark, not included in a pale spot in front of crossvein; two separate, round, pale spots past tip of second radial cell, the second spot lying anterior to vein M_1 , small distal pale spots on cells R_5 and M_1 widely separated from margin of wing (pl. 8, fig. 8); eyes narrowly separated; antenna with distal sensory tufts present on segments III, V, VII–X; third palpal segment normal; two spermathecae with long neck; male aedeagus with high basal arch, spines poorly developed; ventral and dorsal roots of basistyle well developed; parameres with serrated tip, short thumblike projection; ninth tergum with long, tapering, apicolateral processes.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, M. D. Delfinado.—Mindanao: Pikit, Cotabato, December 16, 1946, at light, F. G. Werner.

Culicoides (Oecacta) infulatus, new species

The presence of antennal sensoria on segments III–X, XIII–XIV, the absence of pale spots on apices of cells R_5 and M_1 along margin of wing, and the strongly swollen third palpal segment separate *infulatus* from its closely related species, *praesignis*.

Female.—Length about 1.5 mm., wing 0.90 (0.84–0.93, *n*-6) mm. long. Eyes closely approximated (pl. 12, fig. 3), bare. Antenna with flagellar segments in proportion of 40:27:30:30:30:30:30:30:47:51:54:54:74, antennal ratio 1.14 (1.10–1.19, *n*-4); antennal sensoria present on segments III–X, XIII–XIV. Palpal segments in proportion of 17:54:57:27:30; third segment strongly swollen (pl. 11, fig. 3), 2.18 (2.12–2.42, *n*-5) times as long as its greatest breadth, a small sensory pit present distally. Mandible teeth 15 (14–17, *n*-5). Legs brown with dark brown knees, adjacent pale band on tibiae yellowish; hind tibial comb with four spines, the first spine longest. Wing (pl. 8, fig. 7) with costa extending 0.56 (0.53–0.60, *n*-6) of wing length; macrotrichia very sparse, confined to apices of cells R_5

and M_1 . Wing appearing brownish, with second radial cell and distal half of first in a darker spot; pale areas as figured. Transverse dark bands across wing, one before crossvein $r-m$ to middle of anal cell, another at level of radial cells to tip of vein Cu_1 , and a narrow one at middle of cell R_5 anteriorly to tip of vein M_3+4 ; a pale spot past tip of second radial cell appearing as two connected light spots; a distal pale spot on cell R_5 well removed from margin of wing, distal spots on cells M_1 , M_2 and M_4 broadly meeting wing margin; a large pale spot nearly filling base of cell M_1 , and, below this, a spot on cell M_2 posterior to vein M_2 ; also another spot on cell M_2 just behind medial fork; a distal pale spot on anal cell extending along margin of wing to anal angle of cell. Spermathecae (pl. 13, fig. 3) two, sub-spherical, equal, each measuring 0.054 by 0.071 mm.; rudimentary spermatheca present, sclerotized ring absent.

Male.—Unknown.

Holotype.—A female, CNHM-16, Maco, Tagum, Davao, October, 1946, near sea level, H. Hoogstraal and D. Heyneman. In the collection of Chicago Natural History Museum.

Paratypes.—Three females, same data as holotype (2, USNM; 1, PDH); 1 female, CNHM-15, Camp Meran, east slope of Mount Apo, Davao, November 9, 1946, "beating tree ferns," H. Hoogstraal (CNHM).

Plesiotype.—A female, same data as holotype (CNHM).

Culicoides (Oecacta) longipalpis, new species

The long, single radial cell, the much elongate third palpal segment with scattered sensoria, and the pale spot straddling distal third of vein M_1 will serve to distinguish this species readily.

Female.—Length about 1.3 mm., wing 0.99 (0.93–1.05, $n=5$) mm. long. Eyes narrowly separated (pl. 12, fig. 4). Antenna with flagellar segments in proportion of 37:23:23:27:27:30:30:54:57:64:68:88, antennal ratio 1.36 (1.27–1.44, $n=4$); antennal sensoria present on segments III, XI–XV. Palpal segments in proportion of 17:94:128:23:27; third segment long and slender (pl. 11, fig. 4), 4.2 times as long as broad, sensory pit absent but with few, scattered sensoria on distal half. Mandible teeth 12 (10–14, $n=4$). Legs brown; front and hind knees darker brown with adjacent pale band on tibiae, middle knee pale on each side of joint; hind tibial comb with four spines. Wing (pl. 8, fig. 10) with costa extending 0.65 (0.63–0.70, $n=5$) of wing length; macrotrichia long and dense, covering most of wing surface. Anterior radial cells separated, the single radial cell broad at distal half, and tip included in a pale spot. Wing color brown with two darker brown areas on anterior margin of wing; small, rounded, pale spots at wing base covering arculus, over crossvein $r-m$, on tip of anterior radial cell, and on apices of cells R_5 and M_1 broadly separated from margin of wing; a pale spot straddling distal third of vein M_1 posterior to pale spot on tip of radial cell; cell M_2 with double pale spots behind base of medial fork and in front of M_3+4 mediocubital fork, a third one on margin of wing; anal cell with a basal pale spot and apical ones, the

basal one less distinct. Halter pale. Spermathecae (pl. 13, fig. 4) two, suboval, equal, each measuring 0.030 by 0.040 mm.; both rudimentary spermatheca and ring absent.

Male.—Unknown.

Holotype.—A female (CNHM-4), eastern slope of Mount McKinley, 3300 feet alt., Davao, September 25, 1946, at light, F. G. Werner. In the collection of Chicago Natural History Museum.

Paratypes.—Four females, same data as holotype (1, CNHM; 1, PDH; 2, USNM).

***Culicoides (Oecacta) marginatus*, new species**

The general wing pattern relates this species to *damnosus*, from which it can be distinguished by the small distal pale spot on cell R_5 and the presence of antennal sensoria on segments III, XI–XIV.

Female.—Length about 1.5 mm., wing 0.93 (0.89–1.09, $n=13$) mm. long. Eyes narrowly separated, bare. Antenna with flagellar segments in proportion of 37:27:27:30:30:30:30:34:54:57:57:64:81, antennal ratio 1.29 (1.24–1.36, $n=12$); antennal sensoria present on segments III, XI–XIV. Palpal segments in proportion of 17:44:54:30:34; third segment greatly swollen, 2.20 (1.77–2.50, $n=10$) times as long as greatest width (pl. 11, fig. 5), with large, deep, sensory pit and narrow apex. Mandible teeth 10 (9–13, $n=10$). Legs brown with narrow dark knees, pale sub-basal rings on tibiae, four spines on hind tibial comb. Wing (pl. 8, fig. 11) with costa extending 0.56 (0.50–0.68, $n=13$) of wing length; macrotrichia densely scattered over wing surface. Wing brownish with pale markings as figured; a transverse pale spot on costal margin over crossvein $r-m$, and one past tip of second radial cell; in some specimens this appears as a connected double light spot; cells R_5 , M_1 , M_2 , M_4 and Cu_1 each with a small rounded pale spot attaining wing margin; a very distinct pale spot just behind medial fork; anal cell with a large basal pale spot, an apical pale spot transverse from behind vein M_{3+4} and Cu_1 to wing margin; a pale spot past arculus on medial vein occupying basal cells above and below this vein. Halter knob brownish, stem pale. Spermathecae (pl. 13, fig. 5) two, ovoid, equal, each measuring 0.037 by 0.047 mm.; rudimentary spermatheca present, ring absent.

Male genitalia (pl. 14, fig. 1).—Ninth sternum narrow with a broad, deep, median excavation, the ventral membrane bare; ninth tergum long and tapering, the apex broad and truncated with a very shallow, median notch, and large, triangular apicolateral processes. Basistyle stout, mesal hairs absent, the ventral and dorsal roots well-developed; dististyle long, thick at base, narrowing toward tip. Aedeagus massive, the basal arms heavily sclerotized, with the anterior membrane forming a high rounded arch on its basal half, the apex long and truncated, thinly sclerotized. Parameres separate, each with bent, large, knobbed base, nearly straight and slender stem, bare, pointed, curved tip.

Holotype.—A female, Tala, Rizal, May 21, 1958, light trap, M. D. Delfinado. In the collection of the Division of Malaria, Philippine Department of Health.

Allotype.—A male, same data as the holotype.

Paratypes.—Three males, 10 females, same data as the holotype, except May 20, 1958 (4, CNHM; 4, PDH; 3, USNM; 1, BMNH; 1, BPBM); a female, *CNHM-5*, Pikit, Cotabato, December 16, 1946, near sea level, F. G. Werner (CNHM); a female, *CNHM-16*, Maco, Tagum, Davao, October, 1946, near sea level, H. Hoogstraal and D. Heyneman (USNM).

Plesiotype.—A female, *CNHM-11*, Dimanianga, Busuanga Island, Palawan, H. Hoogstraal (CNHM).

Culicoides (Oecacta) mcdowellii, new species

The large distal pale spot on cell R_5 , and the presence of antennal sensoria on segments III–XIV relate this species to *palawanensis*, from which it can be distinguished by the pale banded legs with dark brown knees, the pyriform spermathecae with wide opening to ducts, and the large sensory pit with an extremely wide opening near apex of segment.

Female.—Length about 1.5 mm., wing 0.99 (0.89–1.03, $n=18$) mm. long. Eyes separated (pl. 12, fig. 5), bare. Antenna with flagellar segments in proportion of 44:27:34:34:34:34:34:57:57:68:68:81, antennal ratio 1.21 (1.14–1.30, $n=15$); antennal sensoria present on segments III–XIV. Palpal segments in proportion of 20:54:64:20:23; third segment (pl. 11, fig. 6) greatly swollen, 2.06 (1.88–2.25, $n=8$) times as long as its greatest breadth, a large, deep sensory pit with an extremely broad opening near apex of segment. Mandible teeth 13 (12–16, $n=13$). Legs banded, with darker brown knees; four spines on hind tibial comb, the first spine nearest the spur longest. Wing (pl. 8, fig. 12) with costa extending 0.64 (0.57–0.67, $n=18$) of wing length; macrotrichia long and densely distributed over most of wing surface. Wing markings practically the same as those of *ejercitoi*, but pale markings of wing not as distinct as those found in *ejercitoi*; second radial cell and nearly all of first blackish; diffuse dark spots at wing base, and anal cell with a broad dark streak from base to near apex. Halter brownish. Spermathecae (pl. 13, fig. 6) two, subequal, slightly pyriform, measuring 0.044 by 0.054 and 0.047 by 0.054 mm., with wide opening to duct; rudimentary spermatheca present, ring absent.

Male.—Unknown.

Holotype.—A female, *CNHM-12*, Siuk, Calamianes, Culion Island, Palawan, April 7, 1947, near sea level, "Z. C." In the collection of Chicago Natural History Museum.

Paratypes.—Seven females, same data as the holotype (2, CNHM; 1, PDH; 2, USNM; 1, BPBM; 1, BMNH); 6 females, *CNHM-10*, San Pedro, Culion Island, Palawan, March 26, 1947, near sea level, H. Hoogstraal (1, CNHM; 1, USNM; 4, PDH); 1 female, *CNHM-11*,

Dimanianga, Busuanga Island, Palawan, March, 1947, near sea level, H. Hoogstraal (CNHM); 2 females, CNHM-13, Bacungan, Palawan, March 20, 1947, F. G. Werner (1, CNHM; 1, PDH).

Plesiotype.—A female, same data as the holotype (CNHM).

Remarks.—This species is dedicated to Dr. John McDowell, who served as Technical Adviser to the International Cooperation Administration and Malaria Consultant in the Department of Health, Manila, Philippines.

Culicoides (Oecacta) notatus, new species

This species is readily distinguished from its closely related species, *schultzei* and *perornatus*, by the presence of only one pale spot posterior to pale spot beyond end of second radial cell, and by the slender and longer second palpal segment.

Female.—Length about 1.3 mm., wing 0.88 mm. long. Eyes closely approximated (pl. 12, fig. 6), bare. Antenna with flagellar segments in proportion of 37:27:27:27:27:27:27:47:54:61:68:88, antennal ratio 1.40; antennal sensoria present on segments III, VII–X. Palpal segments in proportion of 17:68:61:23:30; third segment strongly swollen (pl. 11, fig. 7), 2.65 times as long as its greatest breadth, greatly narrowed beyond large, shallow, sensory pit. Mandible with 12 teeth. Legs brownish with narrow dark knees, broad adjacent pale band on femora and tibiae yellowish; apex of hind tibia pale; hind tibial comb with four spines, the spine nearest the spur longest. Wing (pl. 8, fig. 13) with costa extending 0.56 of wing length; sparse macrotrichia on apices of cells R_5 and M_1 . Wing with marked pale and dark areas, second radial cell and tip of first blackish. Base broadly pale, a large pale area over crossvein *r-m* from anterior wing margin extending posteriorly to level of anterior mediocubital fork; two pale spots past tip of second radial cell, one light spot on each of the apices of cells R_5 , M_1 , M_2 and M_4 broadly meeting margin of wing, cell M_1 also with a linear light spot extending from base to pale rounded spot at middle of cell, the pale spot on apex of cell R_5 subtriangular; a large pale spot in anal cell connected posteriorly along wing margin to large basal pale area; vein M_1 pale-margined at distal half. Halter brownish. Spermathecae (pl. 13, fig. 7) two, subequal, suboval, measuring 0.037 by 0.051 and 0.034 by 0.047 mm.; rudimentary spermatheca and a large, chitinized ring present.

Male.—Unknown.

Holotype.—Female, CNHM-16, Maco, Tagum, Davao, October, 1946, near sea level, H. Hoogstraal and D. Heyneman. In the collection of Chicago Natural History Museum.

Paratype.—A female, same data as holotype (USNM).

Culicoides (Oecacta) palawanensis, new species

The pale wing markings follow those of *cordiger*, but this species differs from *cordiger* in the absence of black, stigmatic spots on

the second radial cell, the distal half of the first, and the middle of cell R_5 . The unbanded legs and remarkably large third palpal segment readily separate *palawanensis* from *mcdownelli*.

Female.—Length about 1.5 mm., wing 1.03 (0.95–1.13, $n=10$) mm. long. Eyes widely separated above, greatly narrowing posteriorly (pl. 12, fig. 7), bare. Antenna with flagellar segments in proportion of 40:23:27:27:27:27:27:27:68:64:68:71:98, antennal ratio 1.53 (1.48–1.62, $n=4$); antennal sensoria present on segments III–XIV. Palpal segments in proportion of 20:51:74:27:34; third segment greatly swollen (pl. 11, fig. 8), 2.34 (2.00–2.40, $n=10$) times as long as broad, with a large, deep, sensory pit on distal half. Mandible teeth 13 (12–16, $n=13$). Legs entirely brown, unbanded; hind tibial comb with four spines, the one nearest the spur longest. Wing (pl. 8, fig. 14) with costa extending 0.68 (0.65–0.75, $n=10$) of wing length; macrotrichia sparsely distributed on basal half of wing and anal cell. Wing brownish with second radial cell and distal half of first darker brown. The pale markings follow those of *cordiger* Macfie, but lack the black, stigmatic spots on second radial cell and distal half of first, and middle of cell R_5 of *cordiger*; the marginal pale spots on cells R_5 , M_1 , M_2 , and M_4 barely discernible from the surrounding area. Halter brown. Spermathecae (pl. 13, fig. 8) two, subequal, subspherical, measuring 0.051 by 0.068 and 0.051 by 0.061 mm., with wide openings to duct; rudimentary spermatheca present, ring absent.

Male genitalia (pl. 14, fig. 2).—Ninth sternum broad, with a shallow mesal excavation, the ventral membrane hairy; ninth tergum long and tapering, with large, triangular apicolateral processes, the apical margin between them deeply cleft and bilobed. Basistyle simple, the ventral roots not developed, the dorsal ones long and slender; dististyle short and stout with notched apex. Aedeagus narrow and massive, with broadly truncated, thinly sclerotized apex, the anterior membrane forming a low basal arch. Parameres with main bodies narrowly fused at base; stem broad at base, widely divergent, with pointed, bare tip.

Holotype.—A female, CNHM-10, San Pedro, Culion Island, Palawan, March 26, 1947, near sea level, H. Hoogstraal. In the collection of Chicago Natural History Museum.

Allotype.—A male, same data as the holotype. In the collection of Chicago Natural History Museum.

Paratypes.—One male (USNM), 7 females (2, CNHM; 3, PDH; 2, USNM), same data as holotype; 1 female, CNHM-11, Dimanianga, Busuanga Island, Palawan, March, 1947, near sea level, H. Hoogstraal (CNHM).

Plesiotype.—A female, same data as holotype (CNHM).

Culicoides (Oecacta) wenzeli, new species

This species is readily distinguished by having in the wing pattern only two distinct pale spots, long and abundant macrotrichia covering most of wing surface, and a large, deep sensory pit on the third palpal segment.

Female.—Wing 0.84 mm. long. Eyes contiguous for the length of the diameter of 1.5 facets. Antennae missing. Palpal segments in proportion of 17:44:64:23:30; third segment distinctly swollen (pl. 11, fig. 9), 1.90 times as long as broad, with a large, deep sensory opening at distal half. Mandible teeth small and numerous. Legs brownish; knees yellowish on each side of femora and tibiae; hind tibial comb with four spines, the one nearest the spur longest. Wing (pl. 8, fig. 15) with costa extending 0.53 of wing length; brownish macrotrichia long and abundant, evenly distributed on wing surface. Wing appearing pale, the pattern and venation as figured; the second radial cell in a dark spot but tip of vein R_{4+5} included in a pale spot; two distinct pale spots over crossvein $r-m$, not reaching costal margin of wing, and a small one in cell R_5 at extreme tip of vein R_{4+5} ; other pale areas in apices of cells R_5 , M_1 , and M_2 barely discernible. Halter knob yellowish, stem brown. Spermathecae (pl. 13, fig. 9) two, unequal, pyriform; rudimentary spermatheca and sclerotized ring both present.

Male genitalia (pl. 14, fig. 3).—Ninth sternum narrow, with a broad, deep, median excavation, the ventral membrane hairy; ninth tergum tapering, with long, pointed apicolateral processes, a median notch in the apical margin between them. Basistyle slender and bare, ventral roots poorly developed, the dorsal ones long and slender; dististyle short, thick at basal half, narrowing toward pointed tip. Aedeagus with rounded basal arch extending to three-fourths of total length, the basal arms widely divergent, heavily sclerotized, the distal fourth broad, narrowing to a rounded apex. Parameres separate, each with abruptly bent base, broad stem and very slender, bent, bare, pointed tip.

Holotype.—A female, Tala, Rizal, May 22, 1958, light trap, M. D. Delfinado. In the collection of the Division of Malaria, Philippine Department of Health.

Allotype.—A male, same data as holotype (PDH).

Paratype.—A male, same data as holotype (PDH).

Remarks.—The species is dedicated to Mr. Rupert L. Wenzel, Curator of Insects, Chicago Natural History Museum.

Culicoides (Oecacta) pampangensis, new species

The structure of the epipharyngeal wall of the cibarial pump, the wing pattern, and the much enlarged third palpal segment with deep, large, sensory pit are distinctive features of this species. *Culicoides ejercitoi* resembles *pampangensis* but has extensive pale wing markings with large, pale, apical spots.

Female.—Length about 1.3 mm., wing 1.0 (0.86–1.09, $n=10$) mm. long. Eyes approximated (pl. 12, fig. 8). Antenna with flagellar segments in proportion of 47:30:30:30:30:30:30:30:61:61:74:74:102, antennal ratio 1.52; antennal sensoria present on segments III–XIV. Palpal segments in proportion of 23:61:81:34:34; third segment strongly swollen (pl. 11, fig. 10), 2.19 (2.00–2.40, $n=8$) times as long as its greatest breadth, sensory pit large with a wide opening. Mandible teeth 14 (13–16, $n=10$). Epipharyngeal wall of the cibarial pump with rows of small, blunt spines or papillae. Legs brownish, knee spot indistinct, femora pale at extreme

base, tibiae with narrow basal band; hind tibial comb with four spines, the one nearest the spur longest. Wing (pl. 9, fig. 1) with costa extending 0.63 (0.54–0.70, $n=10$) of wing length; macrotrichia long and dense on distal half of cell R_5 , sparse on cells M_1 and M_2 . Wing pattern as figured; extreme tip of second radial cell included in a pale spot; narrow pale spot at wing base; two prominent, broad, transverse pale bands across wing, the first at level of crossvein $r-m$ to tip of anal cell, and narrowly interrupted by dark stem of mediocubital fork, the second beginning on and including tip of second radial cell and extending to tip of cell M_4 ; lighter pale spot at margin of wing on cell M_2 , absent on cells R_5 and M_1 . Halter brownish. Spermathecae (pl. 13, fig. 10) two, equal, pyriform, each measuring 0.040 by 0.054 mm.; only rudimentary spermatheca present, ring absent.

Male genitalia (pl. 14, fig. 4).—Ninth sternum broad, with deep mesal excavation, the ventral membrane hairy; ninth tergum short and tapering, with long apicolateral processes, the apical margin between them with a deep, median notch. Basistyle short, mesal margin simple, only the dorsal roots developed; dististyle nearly straight, slender. Aedeagus with heavily sclerotized basal arch, width at base 0.7 times total length, anterior membrane covering about distal half of arch; distal stem short, the apex broadly rounded, unsclerotized. Parameres with main bodies joined at bases by a thin loop; knobbed base straight, with stout, short, divergent stem and pointed, bare tip.

Holotype.—A female, Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat. In the collection of the Division of Malaria, Philippine Department of Health.

Allotype.—A male, same data as holotype (PDH).

Paratypes.—Seven females, same data as holotype (3, PDH; 3, USNM; 1, BPBM); 1 female, Tala, Rizal, May 22, 1958, light trap, M. D. Delfinado (BMNH).

Plesiotypes.—One female, same data as holotype (PDH); 1 female, CNHM-11, Dimanianga, Busuanga Island, Palawan, near sea level, H. Hoogstraal (CNHM).

Culicoides (Oecacta) perornatus, new species

The characteristic distal pale spot on cell R_5 , the remarkably swollen third palpal segment with large, deep sensory pit, and the elongate-oval spermathecae with long, chitinized neck are the distinctive features of this species.

Female.—Length about 1.6 mm., wing 1.0 mm. long. Eyes contiguous for the length of the diameter of 3.5 facets (pl. 12, fig. 9). Antennae missing. Palpal segments in proportion of 20:37:61:23:37; third segment greatly swollen (pl. 11, fig. 11), 2.0 times as long as broad with a large, deep sensory pit at middle. Mandible teeth 10. Legs brown; knees with a narrow darker brown band, with adjacent yellowish band on front and middle tibiae; fore and mid femora banded; base and apex of hind tibia pale, tibial comb with four spines. Wing (pl. 9, fig. 2) with costa extending 0.63 of wing length; macrotrichia fairly abundant over distal half of

wing surface, few in anal cell. Wing pattern very characteristic, as shown in figure; second radial cell and distal end of first in a dark spot; diffuse pale areas over wing base past arculus and across basal half of anal cell; a large pale spot over crossvein *r-m* extending posteriorly from costa to medial vein; cell R_5 with a pale spot immediately posterior to another pale spot situated just beyond end of second radial cell, and a third elongate spot on anterior side of vein M_1 posterior to the second rounded spot; distal pale spot irregular in shape, occupying most of distal half of cell, more or less U-shaped and broadly emarginate anteriorly; cells M_1 and M_2 each with marginal pale spots, the spot on cell M_1 apparently reaching margin of wing, the spot on cell M_2 widely separated from wing margin; cell M_4 with a transverse pale spot across middle of cell extending proximally to base of medio-cubital fork and posteriorly along basal fourth of vein Cu_1 ; anal cell with a large, oblique double spot broadly meeting posterior margin of wing. Halter knob brown. Spermathecae (pl. 13, fig. 11) two, elongate oval with long, chitinated neck, subequal, measuring 0.034 by 0.061 and 0.034 by 0.051 mm.; a club-shaped rudimentary spermatheca and ring present.

Male.—Unknown.

Holotype.—A female, CNHM-16, Maco, Tagum, Davao, October, 1946, near sea level, H. Hoogstraal and D. Heyneman. In the collection of Chicago Natural History Museum.

Culicoides (Oecacta) praesignis, new species

C. praesignis is readily distinguished from its closely related species, *infulatus*, by the presence of an additional small pale spot on apices of cells R_5 and M_1 , and antennal sensoria on segments III–XIV.

Female.—Length about 1.6 mm., wing 1.03 mm. long. Eyes very narrowly separated (pl. 12, fig. 10), bare. Antenna with flagellar segments in proportion of 44:30:30:30:30:30:30:30:47:51:57:85, antennal ratio 1.31; antennal sensoria present on segments III–XIV. Palpal segments in proportion of 17:40:61:23:27; third segment distinctly swollen (pl. 11, fig. 12), 2.0 times as long as its greatest breadth, sensory pit large and deep, with opening near apex. Mandible teeth 13. Legs brown with darker brown knees, narrow sub-basal band on tibiae yellowish, four spines on hind tibial comb. Wing (pl. 9, fig. 3) with costa extending 0.64 of wing length; macrotrichia sparse on apices of cells M_1 , M_2 , M_4 and anal cell. Wing appearing dark with second radial cell and distal half of first on a blackish spot; three well-defined, rounded pale spots, one extending from anterior margin over crossvein *r-m*, another situated past tip of second radial cell and broadly connected to a posterior one below cell, and another on cell R_5 midway between this pale spot and wing tip, and well separated from margin of wing; also on cell R_5 a small pale spot at extreme tip of wing just above vein M_1 ; two rounded pale spots on cell M_1 , and an additional small spot at tip along margin of wing; cell M_2 with a large pale spot behind medial fork, another between this one and the distal pale spot on margin of wing, and another at base of cell connected anteriorly to a pale spot straddling base of medial vein; anal cell with a distinct pale spot just behind mediocubital fork and a smaller one below it along margin of wing. Vein M_1 appearing pale-

margined. Halter knob brown, stem pale. Spermathecae two, subequal, pyriform, measuring 0.037 by 0.057 and 0.033 by 0.057 mm.; rudimentary spermatheca and ring both present.

Male.—Unknown.

Holotype.—A female, *CNHM-16*, Maco, Tagum, Davao, October, 1946, near sea level, H. Hoogstraal and D. Heyneman. In the collection of Chicago Natural History Museum.

Culicoides (Oecacta) schultzei (Enderlein)

Ceratopogon schultzei Enderlein, 1908, Denkschr. med. naturw. Ges. Jena, **13**: 459 (male, female; Südwestafrika; wing and male genitalia illus.).

Culicoides schultzei (Enderlein) Carter, Ingram and Macfie, 1920, Ann. Trop. Med. Parasit., **14**: 231 (redescr. male, female, pupa, larva; Gold Coast; antenna, scutum, wing, and male genitalia illus.).

Diagnostic characters.—Wing with pale and dark markings well defined, pale spots on cell R_5 rather variable, the distal one usually hourglass-shaped (pl. 9, fig. 4); eyes widely separated; third palpal segment enlarged, with large sensory pit; knees dark, with adjacent pale band on tibiae, fore and mid femora; hind tibial comb with four spines; two well-developed spermathecae and a rudimentary spermatheca which is variable in size; male aedeagus with simple, wide basal arch, large, stout distal half; parameres slender, with pointed tips; basistyle with dorsal and ventral roots long, pointed, well developed; ninth tergum with apicolateral processes long, tapering.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, June 1, 1958, light trap, I. Balatbat; Tala, Rizal, May 21–22, 1958, light, M. D. Delfinado; Balbalasang, March, 1913, and January, 1915.—Mindanao: Kidapawan, Cotabato, June–August, 1956, December, 1957, carabao-baited trap, F. Kalaw; Tagum, Davao, May 30, 1956, B. Fontanilla; eastern Zamboanga, August, 1956, carabao-baited trap, D. Casimiro.

Subgenus Avaritia Fox

Avaritia Fox, 1955, Jour. Agric. Univ. Pto. Rico, **39**: 218.

Type of the subgenus: *Ceratopogon obsoletus* Meigen, by original designation.

Species having two well-developed spermathecae; wing with faint markings, scanty macrotrichia, second radial cell usually in a pale spot; antenna with distal sensory tufts present on segments III, XI or XII–XV; male genitalia with apicolateral processes absent; dorsal and ventral roots of basistyle well developed; aedeagus various; parameres simple, tapering to a pointed tip.

Included species: *actoni*, *brevipalpis*, *boophagus*, *jacobsoni*, *nudi-palpis*, *orientalis*, *pungens*, *radicitus*.

Culicoides (Avaritia) actoni Smith

Culicoides actoni Smith, 1929, Indian Jour. Med. Res., **17**: 255 (female; India; palp, wing, and spermathecae illus.).

Diagnostic characters.—Wing brownish with two distinct large pale spots on cell R_5 , one at tip of second radial cell, the second at apex, broadly meeting margin of wing; other pale areas more or less faint (pl. 9, fig. 5); eyes just touching, hairy between facets; antenna with distal sensory tufts present on segments III, XII–XV; third palpal segment slightly swollen, with small sensory pit; front and middle knees yellowish on femora and tibiae, base of hind tibia yellowish; hind tibial comb with five spines; two well-developed spermathecae; male aedeagus narrow with high basal arch, thin anterior membrane near base of arch; parameres with simple pointed tips; dorsal and ventral roots of basistyle well developed; anterior margin of ninth tergum bilobed, apicolateral processes absent.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat.—Mindanao: Eastern slope of Mount McKinley, Davao, August 28, 1946, F. G. Werner.

Culicoides (Avaritia) brevipalpis, new species

This species is closely related to *radicitus*, but differs in having pale base and dark apex of vein M_2 ; brownish halter; unbanded legs; and scarcely swollen, unmodified third palpal segment.

Female.—Length about 1.2 mm., wing 0.93 mm. long. Eyes contiguous for the length of the diameter of two facets (pl. 12, fig. 11), bare. Antennal segments in proportion of 37:27:27:27:27:27:30:40:44:47:51:81, antennal ratio 1.47; antennal sensoria present on segments III, XI–XV. Palpal segments in proportion of 10:30:34:27:23; third segment not modified (pl. 11, fig. 13), scarcely swollen, twice as long as broad, with a broad, shallow sensory pit on apical half. Mandible teeth 12. Legs unbanded, with knees slightly pale on femora and tibiae; five spines on hind tibial comb. Wing (pl. 9, fig. 6) with costa extending 0.56 of wing length; macrotrichia absent. Wing predominantly pale, pattern as figured, distal half of second radial cell included in a pale spot. Dark spots covering distal half of first radial cell and the proximal half of second cell to anterior vein M_1 , across middle of distal half of cell R_5 , and continued along fold of vein M_1 to wing tip, forming a large pale apical spot at margin of wing; diffuse dark area on base of wing just proximad of broad pale spot from costa to media; a large dark spot on tip of vein M_1 narrowly separated posteriorly from dark spot on apex of vein M_2 and continued proximad along this vein to near base; entire vein Cu_1 and tip of vein M_{3+4} dark; anal cell with two small, rounded dark spots, one below mediocubital vein midway between base and fork, the second on mid-margin of cell. Halter brownish. Spermathecae (pl. 13, fig. 12) two, subequal, subspherical; a bulbous rudimentary spermatheca and ring both present.

Male.—Unknown.

Holotype.—A female, Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat. In the collection of Division of Malaria, Philippine Department of Health.

Culicoides (Avaritia) boophagus Macfie

Culicoides boophagus Macfie, 1937, Proc. Roy. Ent. Soc. London, (B), 6: 116 (female; Malaya, on cattle).

Diagnostic characters.—Wing with extensive pale areas, two prominent dark spots on anterior margin, the first over vein R_1 covering apical third of first and proximal half of second radial cells, the second at middle of cell R_5 , stopping before dark linear line running anteriorly along vein M_1 ; mediocubital fork pale-margined along veins M_{3+4} and Cu_1 , apices of these veins dark; dark streak on anal cell broad, interrupted before posterior margin of wing (pl. 9, fig. 7); third palpal segment with distinct sensory pit; front and middle knees pale on tibiae and femora, hind leg with brown femur, tibia with yellowish base, five spines on tibial comb; two well-developed spermathecae.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, I. Balatbat.

Culicoides (Avaritia) jacobsoni Macfie

Culicoides jacobsoni Macfie, 1934, Tijdschr. Ent., 77: 215 (male; Sumatra; genitalia illus.).

Diagnostic characters.—Pale markings on wing less extensive, distal pale spots on cells R_5 and M_1 not reaching margin of wing, dark streak on anal cell interrupted at distal third (pl. 9, fig. 8); eyes contiguous; third palpal segment swollen, with distinct sensory pit; knees dark, front and middle knees with adjacent pale band on tibiae and femora; hind tibial comb with five spines; halter yellowish; two well-developed spermathecae.

Distribution.—Mindanao: Maco, Tagum, Davao, October, 1946, H. Hoogstraal and D. Heyneman.

Culicoides (Avaritia) nudipalpis, new species

The scattered, hyaline sensoria, which form a rounded, pitted spot on the third palpal segment, the whitish halter, and the extensive pale spots of wing readily separate this species.

Female.—Length about 1.3 mm., wing 0.85 (0.77–1.02, $n=9$) mm. long. Eyes contiguous for the length of the diameter of two facets (pl. 12, fig. 12), bare. Antenna with flagellar segments in proportion of 34:23:23:27:27:30:30:44:47:51:51:74, antennal ratio 1.14 (1.09–1.18, $n=4$); antennal sensoria present on segments III, XI–XV. Palpal segments in proportion of 17:40:44:27:30; third segment scarcely swollen (pl. 11, fig. 14), 2.42 (2.16–2.60, $n=4$) times as long as broad, without sensory pit but with scattered, hyaline sensoria forming a rounded, pitted spot. Mandible teeth 13–15. Legs brownish; knees dark with adjacent pale band on front and middle femora and tibiae, and hind tibia; hind femur dark from base to apex; tibial comb with five spines, the one nearest the spur longest. Wing with costa extending 0.47 (0.42–0.51, $n=9$) of wing length; nearly bare, only a few macrotrichia present at wing tip. Pattern as follows: pale spots extensive; distal end of second radial cell and almost all of first cell pale; dark spot over tip of first radial cell and proximal third of second, narrowly extending posteriorly as diffuse patches over

medial fork, and continuing along vein M_2 to wing tip, forming a dark spot on middle of cell M_1 , continuing across cell M_2 to apex of vein M_{3+4} , and over middle of mediocubital fork and vein Cu_1 ; vein M_{3+4} dark-margined; transverse dark spot across middle of cell R_5 from anterior wing margin to fold of vein M_1 , interrupted before dark spot on tip of vein M_1 ; anal cell with two dark spots (pl. 9, fig. 9). Halter yellowish-white. Spermathecae (pl. 13, fig. 13) two, unequal, slightly pyriform, measuring 0.034 by 0.051 and 0.030 by 0.040 mm.; rudimentary spermatheca and ring both present.

Male.—Unknown.

Holotype.—A female, Kidapawan, Cotabato, March 5, 1957, carabao-baited trap, F. Kalaw. In the collection of the Division of Malaria, Philippine Department of Health.

Paratypes.—Three females, same data as the type except June and August, 1956 (1, CNHM; 1, USNM; 1, PDH); 2 females, Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat (1, BMNH; 1, BPBM); a female, Tala, Rizal, May 21, 1958, light trap, M. D. Delfinado (USNM).

Plesiotype.—A female, same data as the holotype except July 13, 1957 (USNM).

***Culicoides (Avaritia) orientalis* Macfie**

Culicoides orientalis Macfie, 1932, Ann. Mag. Nat. Hist., ser. 10, 9: 490 (male, female; Malay States, India, Java; wing and male genitalia illus.).

Diagnostic characters.—Wing with prominent pattern; distal half of second radial cell in a pale spot; apical third of vein M_1 , distal half of vein M_2 , and all of the veins M_{3+4} and Cu_1 dark; a large distal pale spot on cell R_5 nearly filling half of cell; a continuous dark streak on anal cell (pl. 9, fig. 10); eyes contiguous; third palpal segment slightly swollen, with small sensory pit; hind tibial comb with five spines; two well-developed spermathecae; male aedeagus narrow with high basal arch, a lightly sclerotized anterior membrane near base of arch; parameres with simple pointed tips; dorsal and ventral roots of basistyle well developed; anterior margin of ninth tergum with a median notch, apicolateral processes absent.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat.—Mindanao: Kidapawan, Cotabato, August, 1956, carabao-baited trap, F. Kalaw; Maco, Tagum, Davao, October, 1946, H. Hoogstraal and D. Heyneman.

***Culicoides (Avaritia) pungens* de Meijere**

Culicoides pungens de Meijere, 1909, Tijdschr. Ent., 52: 200 (female; Sumatra; antenna and wing illus.).

Diagnostic characters.—Wing appearing brownish with less extensive pale markings, nearly all of first and proximal two thirds of second radial cell dark, apical pale spots on cells R_5 and M_1 widely separated from margin of wing (pl. 9, fig. 11); eyes contiguous; third palpal segment slightly swollen, with shallow sen-

sory pit; legs brown, front and middle knees narrowly dark; hind tibial comb with five spines; halteres brown; two well-developed spermathecae.

Distribution.—Palawan: San Pedro, Culion Island, March 26, 1947, H. Hoogstraal; Balbalasan, March, 1913.

***Culicoides (Avaritia) radicitus*, new species**

The wing pattern of this species is very similar to that of *brevipalpis*, but it is distinguished by the dark base and pale apex of vein M_2 , and by the dark knees adjacent to the pale band on the front and middle femora and tibiae.

Female.—Wing length 0.78 mm. Eyes contiguous for the length of the diameter of two facets, bare. Antenna with flagellar segments in proportion of 30:20:23:23:23:23:23:27:37:40:40:40:57, antennal ratio 1.10; antennal sensoria present on segments III, XI–XV. Palpal segments incomplete. Third palpal segment small, scarcely swollen, sensory pit broad and shallow. Mandible teeth small, numerous. Legs brownish with dark knees, pale adjacent bands on front and middle femora and tibiae, hind femur dark from base to apex; hind tibial comb with five spines, the one nearest the spur longest. Wing (pl. 9, fig. 12) with costa extending 0.49 of wing length; macrotrichia entirely absent. Wing pattern as shown in figure. Three transverse, dark spots on anterior margin of wing, one well before crossvein $r-m$ extending posteriorly to base of media, the second covering distal end of first radial cell and proximal half of second and continued posteriorly to base of medial fork and along vein M_2 before margin of wing, the third across cell R_5 and continued slightly toward wing tip; dark spots at apices of veins M_1 and M_{3+4} , over vein Cu_1 , across cubitoanal veins, and along margin of anal cell. Halter pale. Spermathecae two; both rudimentary spermatheca and ring present.

Male genitalia (pl. 14, fig. 6).—Ninth sternum very narrow, with a broad, median excavation, the ventral membrane bare; ninth tergum parallel-sided, the apical margin with a wide, median notch, divergent lateral lobes, and a pair of submedian, large, triangular, hyaline projections; the apicolateral processes absent. Basistyle slender, simple, the ventral and dorsal roots very well developed, each elongate, slender and curved; dististyle slender and gently curved. Aedeagus twice as long as basal width, the basal arms divergent, sclerotized, the anterior membrane forming a low basal arch, the apex with a large internal sclerotized peg and a slender, blunt tip. Parameres each with bent, thick base; slender stem tapered to pointed, recurved apex.

Holotype.—A male, Tala, Rizal, May 21, 1958, light trap, M. D. Delfinado. In the collection of the Division of Malaria, Philippine Department of Health.

Allotype.—A female, Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat. In the collection of the Division of Malaria.

Paratype.—One male, same data as holotype, except May 22, 1958 (USNM).

Subgenus *Hoffmania* Fox

Hoffmania Fox, 1948, Proc. Biol. Soc. Wash., 16: 21.

Type of the subgenus: *Culicoides inamollae* Fox and Hoffman, by original designation.

Species with two well-developed spermathecae; second radial cell ending in a pale spot; base of cell M_4 pale where it borders the veins at the base of the medio-cubital fork, or apices of veins M_1 , M_2 , M_{3+4} pale; crossvein $r-m$ more or less darkened; antenna with distal sensoria on segments III, XI–XV; hind tibial comb with five spines; male genitalia with the apicolateral processes small or absent; ventral roots of basistyle undeveloped; aedeagus with proximal barlike sclerotization or marginal band.

Included species: *bubalus*, *effusus*, *insignipennis*, *peregrinus*.

Culicoides (*Hoffmania*) *bubalus*, new species

This species is closely related to *peregrinus* Kieffer but can be distinguished from it by the large distal pale spot on cell R_5 and the pale tip of vein M_1 , as well as by the structural characters mentioned in the key.

Female.—Length 1.9 mm., wing 1.3 mm. long. Head dark brown, antennae lighter brown. Eyes contiguous for the length of the diameter of 2.5 facets (pl. 12, fig. 13), bare. Antenna with flagellar segments in proportion of 44:40:47:51:51:51:51:51:74:74:85:85:119, antennal ratio 1.03; antennal sensoria present on segments III, XI–XV. Palpal segments in proportion of 17:64:71:37:37; third segment distinctly swollen (pl. 11, fig. 15), 2.6 times as long as broad, greatly narrowed distally past the moderately large, deep sensory pit. Mandible teeth 18. Legs dark brown; mid-knee narrowly yellowish on each side of joint; front tibia with sub-basal and hind tibia with basal and apical narrow yellowish band; hind tibial comb with six spines, the second spine from the spur longest. Wing (pl. 9, fig. 13) with costa extending 0.88 of wing length; macrotrichia confined to wing margin in apices of cells R_5 , M_1 and M_2 . Wing pattern as figured, the distal half of second radial cell included in a pale spot which extends posteriorly to vein M_1 and outwardly along vein M_1 to pale tip of vein; pale spots on cells M_1 and M_2 straddling middle of vein M_1 and separated from margin of wing; pale spot on cell M_4 continued proximad along vein M_{3+4} to base of medio-cubital fork, and bordering vein Cu_1 posteriorly. Halter brown. Abdomen dark brown, cerci yellowish. Spermathecae (pl. 13, fig. 14) two; rudimentary spermatheca present, ring absent.

Male.—Unknown.

Holotype.—A female, Kidapawan, Cotabato, August, 1956, carabao-baited trap, F. Kalaw. In the collection of the Division of Malaria, Philippine Department of Health.

Culicoides (*Hoffmania*) *effusus*, new species

The extensive pale wing markings, the narrow transverse costal dark spots, and the absence of a common sensory pit on the third palpal segment serve to distinguish this species readily.

Female.—Length about 1.7 mm., wing 1.17 (1.06–1.31, $n=14$) mm. long. Head brown, including palpi and antennae. Eyes contiguous for the length of the diameter of 3.5 facets (pl. 12, fig. 14). Antenna with flagellar segments in proportion of 47:40:47:47:47:47:51:64:64:71:81:115, antennal ratio 1.06 (1.01–1.09, $n=11$); antennal sensoria present on segments III, XI–XV. Palpal segments in proportion of 23:61:68:34:34; third segment swollen at middle (pl. 11, fig. 16), 2.4 times as long as its greatest breadth, common sensory pit absent but with scattered sensoria. Mandible teeth 14 (11–15, $n=10$). Legs brown; knees yellowish on each side of joints; hind tibia with pale, narrow, apical band; five spines on comb, the second from the spur longest. Wing (pl. 9, fig. 14) with costa extending 0.80 (0.71–0.92, $n=14$) of wing length; macrotrichia confined to apices of cells M_1 , R_5 , and M_3 and arranged in rows between veins M_1 , M_2 , and M_{3+4} . Yellowish pale wing markings extensive, limiting the costal dark spots to narrow, transverse band as shown in figure. Almost all of second radial cell included in a large pale spot. Tips of veins M_1 and M_2 appearing pale. Pale spot on cell M_1 distad to pale spot straddling vein M_2 but well separated from wing margin, on cell M_2 the distal pale spot broadly meeting margin of wing; two pale spots on cell M_4 at base of mediocubital fork, completely isolated from the distal pale spot. Halter brownish. Abdomen brown, cerci yellowish. Spermathecae (pl. 13, fig. 15) two, pyriform, subequal, measuring 0.037 by 0.057 and 0.040 by 0.051 mm.; rudimentary spermatheca and sclerotized ring both present.

Male.—Unknown.

Holotype.—A female, *CNHM-4*, from eastern slope of Mount McKinley, 3300 feet alt., at light, September 25, 1946, F. G. Werner. In the collection of Chicago Natural History Museum.

Paratypes.—Three females, *CNHM-16*, Maco, Tagum, Davao, near sea level, October, 1946, H. Hoogstraal and D. Heyneman (2, *CNHM*; 1, *USNM*); 4 females, *CNHM-4*, Todaya, east slope of Mount Apo, 2800 feet alt., November, 1946, H. Hoogstraal (1, *CNHM*; 3, *USNM*); 3 females, Tagum, Davao, July, 1957, I. Puhawan (1, *PDH*; 2, *USNM*); 1 female, Kidapawan, Cotabato, March 5, 1956, F. Kalaw (*PDH*); 1 female, Taft, Samar, May 3, 1956, I. Balatbat (*PDH*); 1 female, Clark Air Base, Angeles, Pampanga, September 7, 1957, from carabao-baited trap, I. Balatbat (*USNM*); 7 females, Kidapawan, Cotabato, July and August, 1956, carabao-baited trap, F. Kalaw (2, *BMNH*; 1, *BPBM*; 4, *PDH*).

Culicoides (Hoffmania) insignipennis Macfie

Culicoides insignipennis Macfie, 1937, Ann. Trop. Med. Parasit., 31: 469 (female; Malaya; wing illus.).

Diagnostic characters.—Wing with second radial cell in a pale spot, crossvein $r-m$ dark, costa extending through pale spot with tip touching third dark spot, apices of veins M_1 , M_2 and M_{3+4} more or less pale, two pale spots on cell M_4 , one at base of cell and the second at apex of cell along margin of wing (pl. 9, fig. 15); eyes contiguous; third palpal segment moderately swollen, with small, shallow

sensory pit; legs dark brown, knees yellowish, hind tibia narrowly yellowish at base and apex; two spermathecae suboval, well sclerotized.

Distribution.—Mindanao: Kidapawan, Cotabato, December 13, 1957, carabao-baited trap, F. Kalaw.

Culicoides (Hoffmania) peregrinus Kieffer

Culicoides peregrinus Kieffer, 1910, Mem. Indian Mus., 2: 191 (female; India; wing illus.).

Diagnostic characters.—Wing with second radial cell pale, apices of veins M_1 , M_2 and M_{3+4} pale, distal pale spot on cell R_5 narrow and transverse (pl. 10, fig. 1); eyes just touching; antenna with distal sensory tufts present on segments III, XI–XV; third palpal segments with divided sensory pits; legs dark with a pale basal band on femora and tibiae, and a pale apical band on fore and mid femora; hind tibial comb with five–six spines; two well-developed spermathecae; male aedeagus elongate, slender, with anterior sclerotized marginal band and spherical tip; basistyle with hairy inner margin, short dorsal and ventral roots; parameres slender, tapering to curved, hairy tips; ninth tergum rounded apically with median notch, apicolateral processes absent.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat; Tala, Rizal, May 22, 1958, light trap, M. D. Delfinado; La Trinidad, May, 1914; Port Banga, January, 1915.—Mindanao: Pikit, Cotabato, August, 1956, July 13, 1957, carabao-baited trap, F. Kalaw; eastern Zamboanga, August, 1956, carabao-baited trap; Tagum, Davao, May 30, 1956, carabao-baited trap, B. Fontanilla.

Subgenus Culicoides Latreille

Culicoides Latreille, 1809, Gen. Crust. et Ins., 4: 251.

Type of the subgenus: *Culex pulicaris* Linn., as *Ceratopogon punctatus* Meigen, monobasic.

Species with two well-developed spermathecae; second radial cell ending in a pale spot; base of cell M_4 dark at base of mediocubital fork and only tip of vein M_1 pale; crossvein $r-m$ always pale; pale spot in cell M_2 anterior to mediocubital fork always present; antenna with distal sensory tufts present on segments III, XI–XV; tibial comb with five–six spines; male genitalia with apicolateral processes absent or poorly developed; basistyle with ventral roots undeveloped; aedeagus usually with anterior marginal band, distal peg and spherical tip; parameres abruptly bent at base, tapering to curved pointed, hairy or bare tips.

Included species: *assimilis*, *gemellus*, *gymnopterus*, *hirtipennis*, *malayae*, *recurvus*, *sumatrae*, *unicus*.

Culicoides (Culicoides) assimilis, new species

This species is closely related to *recurvus* and *hirtipennis* in having the elongate third palpal segment and a pale spot in cell M_2 anterior

to the mediocubital fork, but it may be readily distinguished from them by the contiguous eyes.

Female.—Length about 1.5 mm., wing 1.02 (0.96–1.05, $n=3$) mm. long. Eyes contiguous for the length of 2.5 facets (pl. 12, fig. 15). Antenna with flagellar segments in proportion of 37:34:34:37:37:37:37:40:54:51:57:64:91, antennal ratio 1.09 (1.08–1.12, $n=3$); antennal sensoria present on segments III, XI–XV. Palpal segments in proportion of 17:24:47:30:27; third segment swollen (pl. 11, fig. 17), 2.55 (2.33–2.83, $n=3$) times as long as its greatest breadth, with a moderately large, deep sensory pit. Mandible teeth 18. Legs brown; front knee narrowly dark with adjacent pale ring on tibia; middle knee broadly pale on femur and tibia; front and hind femora dark from base to apex, base and apex of latter yellowish; comb with five spines, the second from the spur longest. Wing (pl. 10, fig. 2) with costa extending 0.68 (0.63–0.71, $n=3$) of wing length, with very few macrotrichia on apices of cells R_5 and M_1 along margin of wing. Wing with pale areas on the following: over distal half of second radial cell, at wing base, over crossvein $r-m$ (may or may not be separated anteriorly from costal pale spot), on cell R_5 before anterior wing margin, and on cell M_2 , narrowly separated from margin of wing; tip of vein M_1 appearing pale. Halter yellowish. Spermathecae (pl. 13, fig. 16) two, subspherical, unequal, measuring 0.047 by 0.057 and 0.034 by 0.044 mm.; rudimentary spermatheca and ring both present.

Male.—Unknown.

Holotype.—A female from Kidapawan, Cotabato, July 13, 1957, carabao-baited trap, F. Kalaw. In the collection of the Division of Malaria, Philippine Department of Health, Manila.

Paratypes.—Three females, same data as the holotype, except June and August, 1956 (1, PDH; 2, USNM); 1 female, CNHM-16, Maco, Tagum, Davao, October, 1946, near sea level, H. Hoogstraal and D. Heyneman (CNHM); 1 female, Tala, Rizal, May 20, 1958, light trap, M. D. Delfinado (PDH); 1 female, Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat (CNHM).

Culicoides (Culicoides) gemellus Macfie

Culicoides gemellus Macfie, 1934, Ann. Trop. Med. Parasit., 28 (2), p. 192 (female; North Borneo; wing illus.).

Diagnostic characters.—Wing with the single radial cell extending through pale spot to distal dark area on cell R_5 , pale spots on cells R_5 and M_1 separated from margin of wing, base of cell M_4 dark (pl. 10, fig. 3); eyes contiguous; antenna with distal sensory tufts present on segments III, XI–XV; third palpal segment elongate with small, scattered sensoria; legs dark brown with bases of all tibiae yellowish; hind tibial comb with six spines; two well-developed spermathecae.

Distribution.—Luzon: Solano, Nueva Viscaya, November 22, 1955, carabao-baited trap.—Visayas: Taft, Samar, November 26, 1955, May 3, 1956, carabao-baited trap, I. Balatbat.—Mindanao: Pikit, Cotabato, December 16, 1946, at light, F. G. Werner; Burung-

kot, Upi, Cotabato, January 1-6, 1947, F. G. Werner; Kidapawan, Cotabato, June, 1956, carabao-baited trap, F. Kalaw; Tagum, Davao, May 30, 1956, carabao-baited trap, B. Fontanilla; eastern Zamboanga, August, 1956, carabao-baited trap, D. Casimiro.

Culicoides (Culicoides) gymnopterus Edwards

Culicoides gymnopterus Edwards, 1926, Sarawak Mus. Jour., 3: 247 (female, male; Sarawak; wing and male genitalia illus.).

Diagnostic characters.—Wing with the second radial cell short, ending in a pale spot a considerable distance from third dark spot; cell R_5 with pale spot broadly meeting anterior margin of wing; wing brownish with pale spots appearing yellowish, dark spots as follows: a broad one at base proximad to pale spot over crossvein $r-m$, two transverse, narrow ones over distal half of second and proximal third of first radial cells, and across middle of cell R_5 (pl. 10, fig. 4); legs largely brown; hind tibial comb with six spines; ninth tergum rounded apically with hyaline medial lobe, the apicolateral processes absent; basistyle with poorly developed ventral roots, short, pointed dorsal roots; dististyle slender, curved to a blunt apex; aedeagus narrow, with anterior marginal band near base of arch, a long, slender distal peg, and a ball-like tip; parameres separate, stem rather broad, abruptly tapering to recurved, pointed tip.

Distribution.—Calapan, Mindoro, I. II. 1916, F. W. Edwards. In the collection of the Museum Zoologicum Universitatis, Helsinki, Finland.

Culicoides (Culicoides) hirtipennis, new species

This species is related to *recurvus*, which has very similar wing pattern and male genitalia. In *C. hirtipennis* vein R_{4+5} is not dark to where vein turns forward to meet costa, front and middle knees are pale, and parameres have a hairy tip.

Female.—Length about 1.14 mm., wing 0.91 mm. long. Eyes widely separated (pl. 12, fig. 16), bare. Antenna with flagellar segments in proportion of 37:30:34:34:34:34:34:44:44:51:54:81, antennal ratio 1.05 (1.02-1.08, $n-2$); distal sensoria present on segments III, XI-XV. Palpal segments in proportion of 13:37:47:23:20; third segment swollen at middle (pl. 11, fig. 18), 2.3 times as long as its greatest breadth, with two sensoria which appear fused into a large, single pit. Mandible teeth 16 (14-18, $n-2$). Legs brown; front and middle knees pale on femora and tibiae; hind femur dark from base to apex; base of hind tibia yellowish; comb with five spines, the second spine from the spur longest. Wing (pl. 10, fig. 5) with costa extending 0.50 of wing length; nearly bare, with few macrotrichia along apical margin of wing. Wing brownish with pale spots appearing yellowish, distal half of second radial cell pale. Pattern as figured, pale spot over crossvein $r-m$ narrowly separated anteriorly from costal white spot; spot on middle of cell R_5 may or may not reach anterior margin of wing; distal pale spots on cells M_2 and M_4 broadly meeting margin of wing; tip of wing in front of vein M_1 slightly pale.

Halter brownish. Spermathecae (pl. 13, fig. 17) two, ovoid, unequal, measuring 0.034 by 0.051 and 0.034 by 0.047 mm.; rudimentary spermatheca and ring both present.

Male genitalia (pl. 14, fig. 5).—Ninth sternum broad, with a deep median excavation, the ventral membrane bare; ninth tergum rounded apically with a well-developed, thinly sclerotized median lobe, the apicolateral processes absent. Basistyle stout with setae on mesal margin, poorly developed ventral roots, short, pointed dorsal roots; dististyle slender, slightly curved to a blunt apex. Aedeagus long and narrow, width at base 0.4 times the total length, the basal arms well sclerotized and stout, a sclerotized anterior band (transverse bar) near base of arch, distal peg absent but with thinly sclerotized membrane forming a small distal arch; apex long and slender with a ball-like tip. Parameres separate, base abruptly bent and slender; stem nearly straight, tapering to recurved haired tip.

Holotype.—A female, CNHM-6, Burungkot, Upi, Cotabato, 1500 feet alt., January 1-6, 1947, net along forest floor, F. G. Werner. In the collection of Chicago Natural History Museum.

Allotype.—A male, same data and depository as holotype.

Paratypes.—A male and female, same data as holotype (USNM).

Culicoides (Culicoides) malayae Macfie

Culicoides malayae Macfie, 1937, Ann. Trop. Med. Parasit., 31 (4), p. 471 (female; Malaya; wing illus.).

Diagnostic characters.—Wing with second radial cell in a pale spot, pale markings extensive, distal pale spots on cells R_5 , M_1 , and M_2 not touching margin of wing, cell M_4 dark at base, the distal pale spot broadly meeting margin of wing (pl. 10, fig. 6); eyes contiguous; third palpal segment moderately swollen, with small, shallow sensory pit; hind femur entirely brown, tibiae with narrow, yellowish band at base and apex; two spermathecae well sclerotized, suboval; male aedeagus with anterior marginal band, distal peg, truncated tip; parameres separate, tips bare; basistyle with ventral roots not developed; ninth tergum with truncated apex, very small apicolateral processes.

Distribution.—Mindanao: Pikit, Cotabato, December 16, 1946, at light, F. G. Werner.

Culicoides (Culicoides) recurvus, new species

The male genitalia of *recurvus* are nearly identical with those of *hirtipennis* to which it is closely related, but *recurvus* may be distinguished by vein R_{4+5} , which is dark up to the point where it turns abruptly forward to meet the costa; also, the front knee is dark, with an adjacent pale band on tibia.

Female.—Length about 1.5 mm., wing 1.03 (0.99-1.06, $n=8$) mm. long. Eyes widely separated (pl. 12, fig. 17), bare. Antenna with flagellar segments in proportion of 44:30:34:34:34:34:37:51:54:61:64:102, antennal ratio 1.17 (1.14-1.20,

n-3); antennal sensoria present on segments III, VII, XI–XV and III, XI–XV. Palpal segments in proportion of 17:44:61:27:30; third segment (pl. 11, fig. 19) greatly swollen, 2.0 times as long as broad, with a large, shallow, sensory pit. Mandible teeth 15 (13–19, *n*-8). Legs brown; front knee dark with adjacent pale ring on tibia; femora dark; bases of middle and hind tibiae yellowish; hind tibial comb with five spines, the second from the spur longest. Wing (pl. 10, fig. 7) with costa extending 0.64 (0.61–0.67, *n*-8) of wing length; nearly bare with only a few macrotrichia at wing tip. Wing brown with limited rounded pale spots appearing yellowish; distal end of second radial cell pale; pale spot over crossvein *r-m* separated anteriorly from costal pale spot by the radial vein; cell *R*₅ with distal pale spot before margin of wing; cells *M*₂ and *M*₄ each with submarginal pale spots, cell *M*₂ also with a double pale spot from just below medial fork to anterior level of mediocubital fork; tip of vein *M*₁ distinctly pale. Halter brown. Spermathecae (pl. 13, fig. 18) two, subspherical, subequal, measuring 0.037 by 0.051 and 0.040 by 0.051 mm.; rudimentary spermatheca and ring both present.

Male genitalia (pl. 14, fig. 7).—Ninth sternum broad, with a shallow median excavation, the ventral membrane bare; ninth tergum rounded apically with a thinly sclerotized median lobe, the apicolateral processes absent. Basistyle slender, mesal margin hairy, only the dorsal roots developed; dististyle thick at base, narrowing toward apex. Aedeagus long and narrow with anterior sclerotized band (transverse bar) near extreme base of arch, very long and slender tip, distal peg absent. Parameres separate, with abruptly bent, small, knobbed base, slender and straight stem, and recurved, pointed, and bare tip.

Holotype.—A female, Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat. In the collection of the Division of Malaria, Philippine Department of Health, Manila.

Allotype.—A male, same data and depository as the holotype.

Paratypes.—Two females, same data as the holotype (1, CNHM; 1, USNM); 1 female, Taft, Samar, May 3, 1956, carabao-baited trap, I. Balatbat (USNM); 1 female, Davao, May, 1956, carabao-baited trap, H. Crisostomo (PDH).

Culicoides (Culicoides) sumatrae Macfie

Culicoides sumatrae Macfie, 1934, Tijdschr. Ent., 77: 215 (male; Sumatra; genitalia illus.); Ann. Trop. Med. Parasit., 28 (2), p. 190 (1934) (female; Malaya, at light).

Diagnostic characters.—Wing with distal half of second radial cell in a pale spot, transverse pale spot at middle of cell *R*₅ reaching anterior margin of wing, pale tip of vein *M*₁, dark base of cell *M*₄ (pl. 10, fig. 8); eyes contiguous; antenna with distal sensory tufts present on segments III, XI–XV; third palpal segment swollen, with small round sensory pit; two well-developed spermathecae; male aedeagus with anterior marginal band, distal peg, and spherical tip; parameres separate, tips bare; basistyle with ventral roots not developed; ninth tergum rounded apically, apicolateral processes absent.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat.—Mindanao: Kidapawan, Cotabato, June and August, 1956, carabao-baited trap, F. Kalaw.

Culicoides (Culicoides) unicus, new species

The wing pattern and venation, and the sensorial pattern of this species ally it to *gemellus* Macfie, but it differs in having prominent, narrow, transverse, dark bands across wing and unbanded legs.

Female.—Length about 1.6 mm., wing 1.29 (1.19–1.42, $n=5$) mm. long. Eyes contiguous for the length of the diameter of four facets (pl. 12, fig. 18), bare. Antennal flagellar segments in proportion of 47:40:44:44:47:47:47:64:61:68:68:115, antennal ratio 1.02 (0.95–1.08, $n=4$); antennal sensoria present on segments III, XI–XV. Palpal segments in proportion of 17:57:68:37:40; third segment elongate, slightly swollen at middle (pl. 11, fig. 20), 3.46 (3.16–4.00, $n=5$) times as long as its greatest width, with a few scattered sensoria on proximal third. Mandible teeth 15 (13–17, $n=5$). Legs yellowish brown, unbanded; hind tibial comb with six spines, the second spine from the spur longest. Wing (pl. 10, fig. 9) with costa extending 0.89 (0.81–0.98, $n=5$) of wing length; almost bare, with only a few macrotrichia at wing tip on cells R_5 and M_1 . Wing pattern and venation as shown in figure. Anterior radial cells separated, the single radial cell long and narrow, extending through pale spot to distal dark area on cell R_5 . Wing predominantly pale, with brown, narrow, irregular, transverse bands across wing; the first dark band before crossvein $r-m$ from costa extending across middle of anal cell to margin of wing; the second at proximal half of anterior radial cell to tip of vein Cu_1 , occupying bases of cells M_1 and M_4 ; the third band across middle of cell R_5 extending from anterior wing margin to tip of vein M_{3+4} , the dark area continued along veins M_1 and M_2 to wing tip, isolating the distal pale spots on cells R_5 , M_1 and M_2 ; the distal pale spots on cells R_5 and M_2 broadly meeting margin of wing. Halter yellowish. Spermathecae (pl. 13, fig. 19) two, slightly subspherical, equal, each measuring 0.037 by 0.051 mm.; rudimentary spermatheca and ring both present.

Male genitalia (pl. 14, fig. 8).—Ninth sternum broad, with shallow median excavation, the ventral membrane bare; ninth tergum rounded apically with well-developed median lobe, the apicolateral processes absent. Basistyle simple, mesal hairs absent, the ventral roots poorly developed, the dorsal roots short, pointed; dististyle long and slender with gently curved apex. Aedeagus long, about twice as long as basal width, the basal arms stout, heavily sclerotized, transverse bar absent but with a thin anterior membrane near base of arch, distal peg present; apex very long and slender with ball-like tip. Parameres separate, each with bent base, thick stem tapering to pointed, bare tip.

Holotype.—A female, CNHM-4, eastern slope of Mount McKinley, Davao, 3300 feet alt., September 25, 1946, at light, F. G. Werner. In the collection of Chicago Natural History Museum.

Allotype.—A male, same data and depository as holotype.

Paratypes.—Four females, same data as holotype (1, CNHM; 1, PDH; 2, USNM).

Subgenus *Trithecoides* Wirth and Hubert

Trithecoides Wirth and Hubert, 1959, Pacific Insects, 1 (1), p. 2.

Type of the subgenus: *Culicoides flaviscutatus* Wirth and Hubert, by original designation.

Species having three well-developed spermathecae; long second radial cell in a pale spot; eyes broadly contiguous; antenna with distal sensory tufts present on segments III, XI–XV; third maxillary palpus usually slender with scattered sensoria on distal surface of segment; male genitalia with apicolateral processes; basistyle with ventral root greatly reduced, dorsal root slender; aedeagus with short basal arch, tapering sides and simple, blunt tip; parameres simple.

Included species: *albibasis*, *baisasi*, *barnetti*, *flavescens*, *flaviscutatus*, *palpifer*, *sarawakensis*.

Culicoides (*Trithecoides*) *albibasis* Wirth and Hubert

Culicoides (*Trithecoides*) *albibasis* Wirth and Hubert, 1959, Pacific Insects, 1 (1), p. 31 (female, male; Malaya, light trap; palp, mandible, spermathecae, wing, and male genitalia illus.).

Diagnostic characters.—Wing largely pale on basal half (pl. 10, fig. 10); halteres dark; legs pale at knees with broad pale band on each side; scutum bright yellow; third palpal segment moderately slender, with sensoria borne on distal surface of segment; mandible with 10–12 small triangular teeth of subequal lengths; three spermathecae unequal, broader than long, with broad unsclerotized entrances to ducts.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, October 15, 1957, light trap, I. Balatbat; San Pablo, Laguna, December 19, 1957, carabao-baited trap, G. Balcita; Tala, Rizal, January 16, May 3, 1956, carabao-baited trap, I. Balatbat.—Mindanao: Kidapawan, Cotabato, January 9, June, August, 1956, F. Kalaw, November 11, 1955, A. Gonzales; Tagum, Davao, May 30, 1956, B. Fontanilla; eastern Zamboanga, November 19, 1955, carabao-baited trap, B. Casimiro.

Culicoides (*Trithecoides*) *baisasi* Wirth and Hubert

Culicoides (*Trithecoides*) *baisasi* Wirth and Hubert, 1959, Pacific Insects, 1 (1), p. 12 (female; Samar, carabao-baited trap; palp, mandible, spermathecae, and wing illus.).

Diagnostic characters.—Wing with large pale spot over crossvein *r-m* covering second radial cell nearly to its base, narrow pale apex (pl. 10, fig. 11); legs distinctly banded; third palpal segment short, stout, with sensoria grouped together on apical third of segment; mandible with eight large, recurved teeth; three spermathecae unequal, without sclerotized necks, with large openings to ducts; parasitic on mosquitoes.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, October 15, 1957, light trap, I. Balatbat; San Pablo, Laguna, December 19, 1955, carabao-baited trap, G. Balcita; Tala, Rizal, January 24, 1956, J. Santos.—Mindanao: Kidapawan, Cotabato, January 9, 1956, F. Kalaw, November 11, 1955, A. Gonzales; Tagum, Davao, May 30, 1956, B. Fontanilla; eastern Zamboanga, November 19, 1955, B. Casimiro.—Visayas: Taft, Samar, January 16, May, 1956, all from carabao-baited traps, I. Balatbat.

Culicoides (Trithecoides) barnetti Wirth and Hubert

Culicoides (Trithecoides) barnetti Wirth and Hubert, 1959, Pacific Insects, 1 (1), p. 32 (female, male; Malaya, light trap; palp, mandible, spermathecae, wing, and male genitalia illus.).

Diagnostic characters.—Wing broadly pale at tip, with a very small dark anterior spot over vein R_1 (pl. 10, fig. 12); halteres pale; hind femora prominently banded; third palpal segment slender, with sensoria borne on distal surface of segment; mandible with about 12 minute triangular teeth; three spermathecae joined a considerable distance before entering duct, the large spermatheca slightly longer than broad.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat; Tala, Rizal, May 21, 1958, light trap, M. D. Delfinado.—Visayas: Taft, Samar, November 26, 1955, carabao-baited trap, I. Balatbat.—Mindanao: Pikit, Cotabato, December 16, 1946, F. G. Werner; Kidapawan, Cotabato, July 13, 1957, carabao-baited trap, F. Kalaw.

Culicoides (Trithecoides) flavescens Macfie

Culicoides anophelis var. *flavescens* Macfie, 1937, Proc. Roy. Ent. Soc. London, (B), 6: 114 (female; Malaya, on cattle).

Culicoides (Trithecoides) flavescens Macfie, new status, Wirth and Hubert, 1959, Pacific Insects, 1 (1), p. 13.

Diagnostic characters.—Wing with extensive pale areas, prominent brown infuscation along veins, two small dark brown spots over vein R_1 and just past end of second radial cell (pl. 10, fig. 13); third palpal segment very slender, with sensoria scattered on surface; apical mandibular teeth very large and widely spaced; three spermathecae subequal, slightly pyriform, with very slender openings to ducts.

Distribution.—Visayas: Taft, Samar, January 6, 1956, carabao-baited trap, I. Balatbat.

Culicoides (Trithecoides) flaviscutatus Wirth and Hubert

Culicoides (Trithecoides) flaviscutatus Wirth and Hubert, 1959, Pacific Insects, 1 (1), p. 34 (female, male; North Borneo, light trap; palp, mandible, spermathecae, wing, and male genitalia illus.).

Diagnostic characters.—Wing with dark brown anterior margin, two large pale spots over crossvein *r-m* and beyond end of second radial cell, narrowly and sometimes faintly pale tip (pl. 10, fig. 14); scutum entirely yellow; hind femora entirely dark; third palpal segment slender, with sensoria borne on distal surface of segment; mandible with about 12 small triangular teeth; three spermathecae unequal, with broad, unsclerotized entrances to ducts, the large one elongate.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat.—Visayas; Taft, Samar, November 15, 1955, carabao-baited trap, I. Balatbat.—Mindanao: Camp Baclayan, eastern slope of Mount Apo, 6000 feet alt., Davao, November 10–13, 1946, "biting man," F. G. Werner.

Culicoides (Trithecoides) palpifer das Gupta and Gosh

Culicoides palpifer das Gupta and Gosh, 1956, Calcutta Sch. Trop. Med. Bull., 4: 122 (female; Calcutta; larvae bred from rotting banana plants).

Diagnostic characters.—Wing with markedly dark areas on costal margin, two very pale spots on middle of crossvein *r-m* and apex of second radial cell, broad pale tip (pl. 10, fig. 15); third palpal segment short, moderately slender, with sensoria borne distally in shallow, open, pit-like area; mandible with 6–8 curved teeth, the distal ones larger; three spermathecae unequal, with large entrances to ducts joined at one point just before the ring.

Distribution.—Luzon: Clark Air Base, Angeles, Pampanga, September 17, 1957, light trap, I. Balatbat; Tala, Rizal, May 21–22, 1958, light trap, M. D. Delfinado.—Mindanao: Maco, Tagum, Davao, October, 1946, near sea level, H. Hoogstraal and D. Heyneman; Tagum, Davao, May 30, 1956, carabao-baited trap, B. Fontanilla; Kidapawan, Cotabato, July 13, 1957, carabao-baited trap, F. Kalaw.

Culicoides (Trithecoides) sarawakensis Wirth and Hubert

Culicoides (Trithecoides) sarawakensis Wirth and Hubert, 1959, Pacific Insects, 1 (1), p. 28 (female; Sarawak, "biting man;" palp, mandible, spermathecae, and wing illus.).

Diagnostic characters.—Wing pattern relatively dark and uniform except for only moderately contrasting pale spots over radial crossvein and distal half of second radial cell (pl. 10, fig. 16); halteres dark; hind femora dark, unbanded; third palpal segment slender, with sensoria borne on distal surface; mandible with 12–13 fine teeth of subequal lengths; three spermathecae unequal, with broad unsclerotized openings to ducts, large spermathecae much longer than broad.

Distribution.—Mindanao: Pikit, Cotabato, December 16, 1946, at light, F. G. Werner.

ACKNOWLEDGMENTS

My sincere gratitude is due to Dr. B. V. Travis, Professor of Entomology, Dr. J. G. Franclemont, Professor of Entomology, and Mr. J. S. Mackiewicz, Instructor in Medical Entomology and Parasitology, all of Cornell University, for their kind help, encouraging interest, and valuable suggestions concerning the manuscript; and to Dr. Clifford C. Gregg, Director of Chicago Natural History Museum, for approving its publication in *Fieldiana*.

I am also grateful to Dr. W. W. Wirth, of the Entomology Research Division, U. S. Department of Agriculture, for the opportunity to study specimens on loan to him from Chicago Natural History Museum, for furnishing valuable information on certain species, and for reading and criticizing the manuscript; and to Dr. R. Frey, of the Museum Zoologicum Universitatis, Finland, for the loan of *Culicoides gymnopterus* Edwards.

The wing photographs were prepared by the Medical Audio Visual Aid unit of the Walter Reed Army Institute of Research, Washington, D.C.

The fellowship granted by the International Cooperation Administration (United States Government) and by the National Economic Council of the Philippines is also gratefully acknowledged.

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INDEX

Current names in roman type, new species and principal references in **bold-faced** type.

- actoni, 637, 653, **654**; pl. 9, fig. 5
albibasis, 633, 640, **666**; pl. 10, fig. 10
arakawai, 635, 639, **640**; pl. 8, fig. 1
assimilis, 637, **660**; pl. 10, fig. 2; pl. 11, fig. 17; pl. 12, fig. 15; pl. 13, fig. 16
Avaritia, 637, **653**
baisasi, 633, 639, **666**; pl. 10, fig. 11
barnetti, 633, 640, **666**, **667**; pl. 10, fig. 12
boophagus, 637, 653, **655**; pl. 9, fig. 7
brevipalpis, 637, 653, **654**, **657**; pl. 9, fig. 6; pl. 11, fig. 13; pl. 12, fig. 11; pl. 13, fig. 12
bubalus, 638, **658**; pl. 9, fig. 13, pl. 11, fig. 15; pl. 12, fig. 13; pl. 13, fig. 14
clavipalpis, 638, **641**; pl. 8, fig. 4
cordiger, 638, 639, 641, **642**, **648**; pl. 8, fig. 5
Culicoides, 633, **633**; s.str., 637, **660**
damnosus, 639, 641, **642**, **646**, pl. 8, fig. 6; pl. 11, fig. 1; pl. 12, fig. 1; pl. 13, fig. 1
effusus, 637, **658**; pl. 9, fig. 14; pl. 11, fig. 16; pl. 12, fig. 14; pl. 13, fig. 15
ejercitoi, 638, 641, **643**, **650**; pl. 8, fig. 9; pl. 11, fig. 2; pl. 12, fig. 2; pl. 13, fig. 2
flavescens, 633, 639, **666**, **667**; pl. 10, fig. 13
flaviscutatus, 633, 640, **666**, **667**; pl. 10, fig. 14
furens, 641
gemellus, 636, **660**, **661**, **665**; pl. 10, fig. 3
guttifer, 635, 639, **640**; pl. 8, fig. 2
gymnopterus, 633, **660**, **662**, **669**; pl. 10, fig. 4
hegneri, 639, 640, **641**; pl. 8, fig. 3
hirtipennis, 637, **660**, **662**, **663**; pl. 10, fig. 5; pl. 11, fig. 18; pl. 12, fig. 16; pl. 13, fig. 17; pl. 14, fig. 5
Hoffmania, 636, **658**
huffi, 638, 641, **644**; pl. 8, fig. 8
inamollae, 658
infulatus, 639, 641, **644**, **652**; pl. 8, fig. 7; pl. 11, fig. 3; pl. 12, fig. 3; pl. 13, fig. 3
insignipennis, 637, 658, **659**; pl. 9, fig. 15
jacobsoni, 637, 653, **655**; pl. 9, fig. 8
judicandus, 633
longipalpis, 638, 641, **645**; pl. 8, fig. 10; pl. 11, fig. 4; pl. 12, fig. 4; pl. 13, fig. 4
malayae, 660, **663**; pl. 10, fig. 6
marginatus, 639, 641, **646**; pl. 8, fig. 11; pl. 11, fig. 5; pl. 13, fig. 5; pl. 14, fig. 1
mcdowellii, 639, 641, **647**, **649**; pl. 8, fig. 12; pl. 11, fig. 6; pl. 12, fig. 5; pl. 13, fig. 6
Monoculicoides, 638, **640**
notatus, 638, 641, **648**, pl. 8, fig. 13; pl. 11, fig. 7; pl. 12, fig. 6; pl. 13, fig. 7
nubeculosus, 640
nudipalpis, 637, 653, **655**; pl. 9, fig. 9; pl. 11, fig. 14; pl. 12, fig. 12; pl. 13, fig. 13
obsoletus, 653
Oecacta, 638, **641**
orientalis, 637, 653, **656**; pl. 9, fig. 10
oxystoma, 633
palawanensis, 639, 641, **647**, **648**, **649**; pl. 8, fig. 14; pl. 11, fig. 8; pl. 12, fig. 7; pl. 13, fig. 8; pl. 14, fig. 2
palpifer, 633, 639, **666**, **668**; pl. 10, fig. 15
pampangensis, 635, 638, 641, **650**; pl. 9, fig. 1; pl. 11, fig. 10; pl. 12, fig. 8; pl. 13, fig. 10; pl. 14, fig. 4
pelliliowensis, 643
peregrinus, 633, 638, 658, **660**; pl. 10, fig. 1
perornatus, 638, 641, **648**, **651**; pl. 9, fig. 2; pl. 11, fig. 11; pl. 12, fig. 9; pl. 13, fig. 11
philippinensis, 633
praesignis, 639, 641, **642**, **644**, **652**; pl. 9, fig. 3; pl. 11, fig. 12; pl. 12, fig. 10

- pulicaris*, 660
punctata, 636
punctatus, 660
pungens, 633, 637, 653, **656**; pl. 9, fig. 11
- radicitus***, 637, 653, 654, 657; pl. 9, fig. 12; pl. 14, fig. 6
- recurvus***, 637, 660, 662, **663**; pl. 10, fig. 7; pl. 11, fig. 19; pl. 12, fig. 17; pl. 13, fig. 18; pl. 14, fig. 7
- sarawakensis*, 633, 640, 666, **668**; pl. 10, fig. 16
- schultzei*, 633, 638, 641, 648, **653**; pl. 9, fig. 4
- sumatrae*, 660, **664**; pl. 10, fig. 8
- Trithecoides*, 636, **666**
- unicus***, 636, 660, **665**; pl. 10, fig. 9; pl. 11, fig. 20; pl. 12, fig. 18; pl. 13, fig. 19; pl. 14, fig. 8
- wenzeli***, 638, 641, **649**; pl. 8, fig. 15; pl. 11, fig. 9; pl. 13, fig. 9; pl. 14, fig. 3

WINGS OF *CULICOIDES*

Subgenus *Monoculicoides* Khalaf

Fig. 1. *C. arakawai* (Arakawa)

Fig. 2. *C. guttifer* de Meijere

Fig. 3. *C. hegneri* Causey

Subgenus *Oecacla* Poey

Fig. 4. *C. clavipalpis* Mukerji

Fig. 10. *C. longipalpis*, new sp.

Fig. 5. *C. cordiger* Macfie

Fig. 11. *C. marginatus*, new sp.

Fig. 6. *C. damnosus*, new sp.

Fig. 12. *C. mcdowelli*, new sp.

Fig. 7. *C. infulatus*, new sp.

Fig. 13. *C. notatus*, new sp.

Fig. 8. *C. hufi* Causey

Fig. 14. *C. palawanensis*, new sp.

Fig. 9. *C. ejercitoi*, new sp.

Fig. 15. *C. wenzeli*, new sp.



WINGS OF *CULICOIDES*

Subgenus *Oecacta*

- Fig. 1. *C. pampangensis*, new sp. Fig. 3. *C. praesignis*, new sp.
Fig. 2. *C. perornatus*, new sp. Fig. 4. *C. schultzei* (Enderlein)

Subgenus *Anartia* Fox

- Fig. 5. *C. actoni* Smith Fig. 9. *C. nudipalpis*, new sp.
Fig. 6. *C. brevipalpis*, new sp. Fig. 10. *C. orientalis* Macfie
Fig. 7. *C. boophagus* Macfie Fig. 11. *C. pungens* de Meijere
Fig. 8. *C. jacobsoni* Macfie Fig. 12. *C. radicitus*, new sp.

Subgenus *Hoffmania* Fox

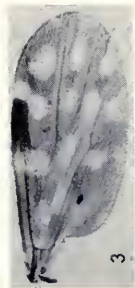
- Fig. 13. *C. bubalus*, new sp. Fig. 14. *C. effusus*, new sp.
Fig. 15. *C. insignipennis* Macfie



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15

WINGS OF *CULICOIDES*

Subgenus *Hoffmania*

Fig. 1. *C. peregrinus* Kieffer

Subgenus *Culicoides* Latr.

Fig. 2. *C. assimilis*, new sp.

Fig. 3. *C. gemellus* Macfie

Fig. 4. *C. gymnopterus* Edwards

Fig. 5. *C. hirtipennis*, new sp.

Fig. 6. *C. malayae* Macfie

Fig. 7. *C. recurvus*, new sp.

Fig. 8. *C. sumatrae* Macfie

Fig. 9. *C. unicus*, new sp.

Subgenus *Trithecoides* Wirth and Hubert

Fig. 10. *C. albibasis* Wirth and Hubert

Fig. 11. *C. baisasi* Wirth and Hubert

Fig. 12. *C. barnelli* Wirth and Hubert

Fig. 13. *C. flavescens* Macfie

Fig. 14. *C. flaviscutatus* Wirth and Hubert

Fig. 15. *C. palpifer* das Gupta and Gosh

Fig. 16. *C. sarawakensis* Wirth and Hubert



PALPS OF *CULICOIDES*

Subgenus *Oecacta* Poey

- | | |
|---|---|
| Fig. 1. <i>C. damnosus</i> , new sp. | Fig. 7. <i>C. notatus</i> , new sp. |
| Fig. 2. <i>C. ejercitoi</i> , new sp. | Fig. 8. <i>C. palawanensis</i> , new sp. |
| Fig. 3. <i>C. infulatus</i> , new sp. | Fig. 9. <i>C. wenzeli</i> , new sp. |
| Fig. 4. <i>C. longipalpis</i> , new sp. | Fig. 10. <i>C. pampangensis</i> , new sp. |
| Fig. 5. <i>C. marginatus</i> , new sp. | Fig. 11. <i>C. perornatus</i> , new sp. |
| Fig. 6. <i>C. mcdowellii</i> , new sp. | Fig. 12. <i>C. praesignis</i> , new sp. |

Subgenus *Avaritia* Fox

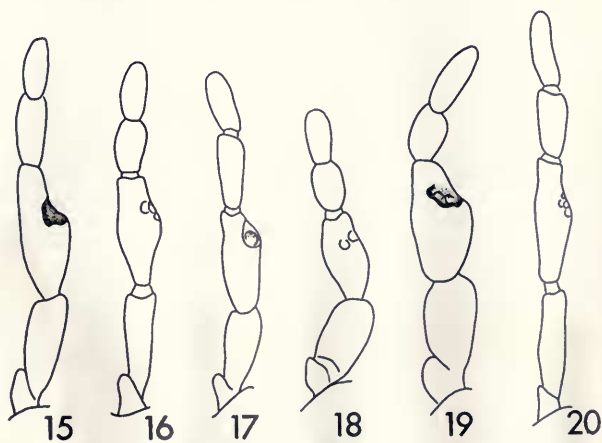
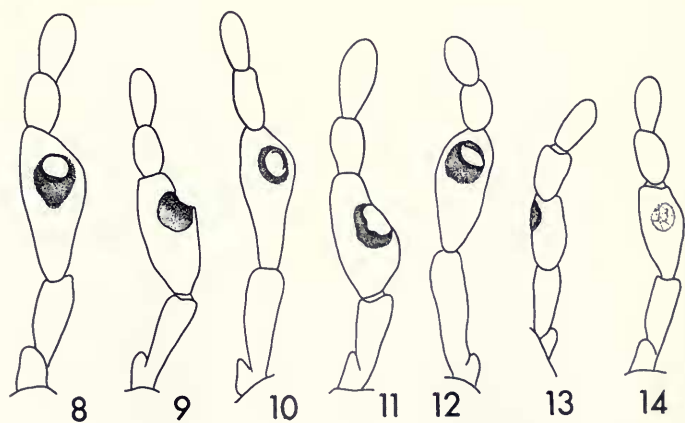
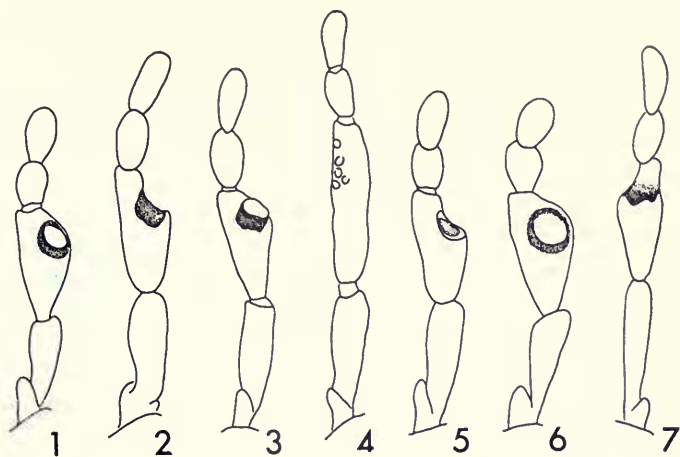
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| Fig. 13. <i>C. brevipalpis</i> , new sp. | Fig. 14. <i>C. nudipalpis</i> , new sp. |
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Subgenus *Hoffmania* Fox

- | | |
|--------------------------------------|--------------------------------------|
| Fig. 15. <i>C. bubalus</i> , new sp. | Fig. 16. <i>C. effusus</i> , new sp. |
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Subgenus *Culicoides* Latr.

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| Fig. 17. <i>C. assimilis</i> , new sp. | Fig. 19. <i>C. recurvus</i> , new sp. |
| Fig. 18. <i>C. hirtipennis</i> , new sp. | Fig. 20. <i>C. unicus</i> , new sp. |



EYES OF FEMALE *CULICOIDES*

Subgenus *Oecacta* Poey

- | | |
|---|--|
| Fig. 1. <i>C. damnosus</i> , new sp. | Fig. 6. <i>C. notatus</i> , new sp. |
| Fig. 2. <i>C. ejercitoi</i> , new sp. | Fig. 7. <i>C. palawanensis</i> , new sp. |
| Fig. 3. <i>C. infulatus</i> , new sp. | Fig. 8. <i>C. pampangensis</i> , new sp. |
| Fig. 4. <i>C. longipalpis</i> , new sp. | Fig. 9. <i>C. perornatus</i> , new sp. |
| Fig. 5. <i>C. mcdowelli</i> , new sp. | Fig. 10. <i>C. praesignis</i> , new sp. |

Subgenus *Avaritia* Fox

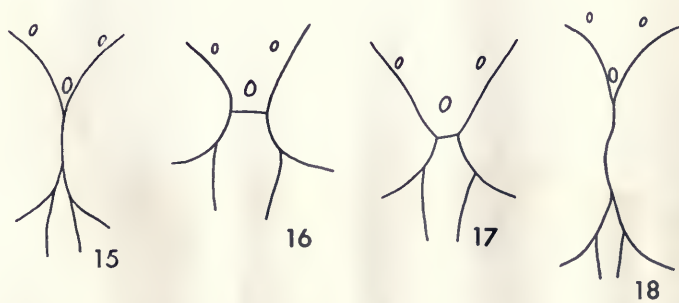
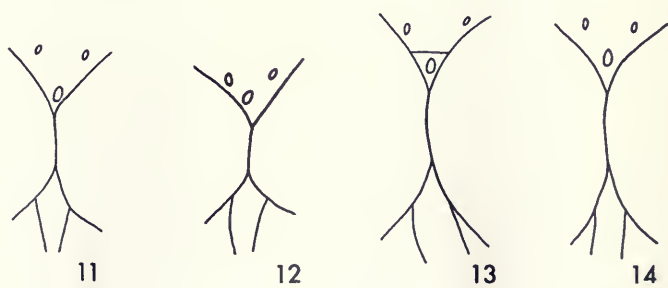
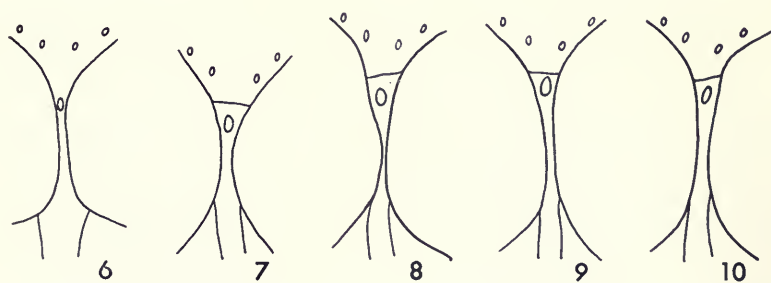
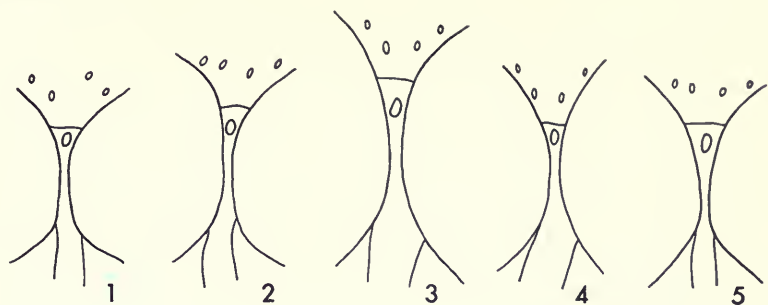
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| Fig. 11. <i>C. brevipalpis</i> , new sp. | Fig. 12. <i>C. nudipalpis</i> , new sp. |
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Subgenus *Hoffmania* Fox

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| Fig. 13. <i>C. bubalus</i> , new sp. | Fig. 14. <i>C. effusus</i> , new sp. |
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Subgenus *Culicoides* Latr.

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| Fig. 15. <i>C. assimilis</i> , new sp. | Fig. 17. <i>C. recurvus</i> , new sp. |
| Fig. 16. <i>C. hirtipennis</i> , new sp. | Fig. 18. <i>C. unicus</i> , new sp. |



SPERMATHECAE OF *CULICOIDES*

Subgenus *Oecacta* Poey

- | | |
|---|---|
| Fig. 1. <i>C. damnosus</i> , new sp. | Fig. 6. <i>C. mcdowelli</i> , new sp. |
| Fig. 2. <i>C. ejercitoi</i> , new sp. | Fig. 7. <i>C. notatus</i> , new sp. |
| Fig. 3. <i>C. infulatus</i> , new sp. | Fig. 8. <i>C. palawanensis</i> , new sp. |
| Fig. 4. <i>C. longipalpis</i> , new sp. | Fig. 9. <i>C. wenzeli</i> , new sp. |
| Fig. 5. <i>C. marginatus</i> , new sp. | Fig. 10. <i>C. pampangensis</i> , new sp. |
| Fig. 11. <i>C. perornatus</i> , new sp. | |

Subgenus *Araritia* Fox

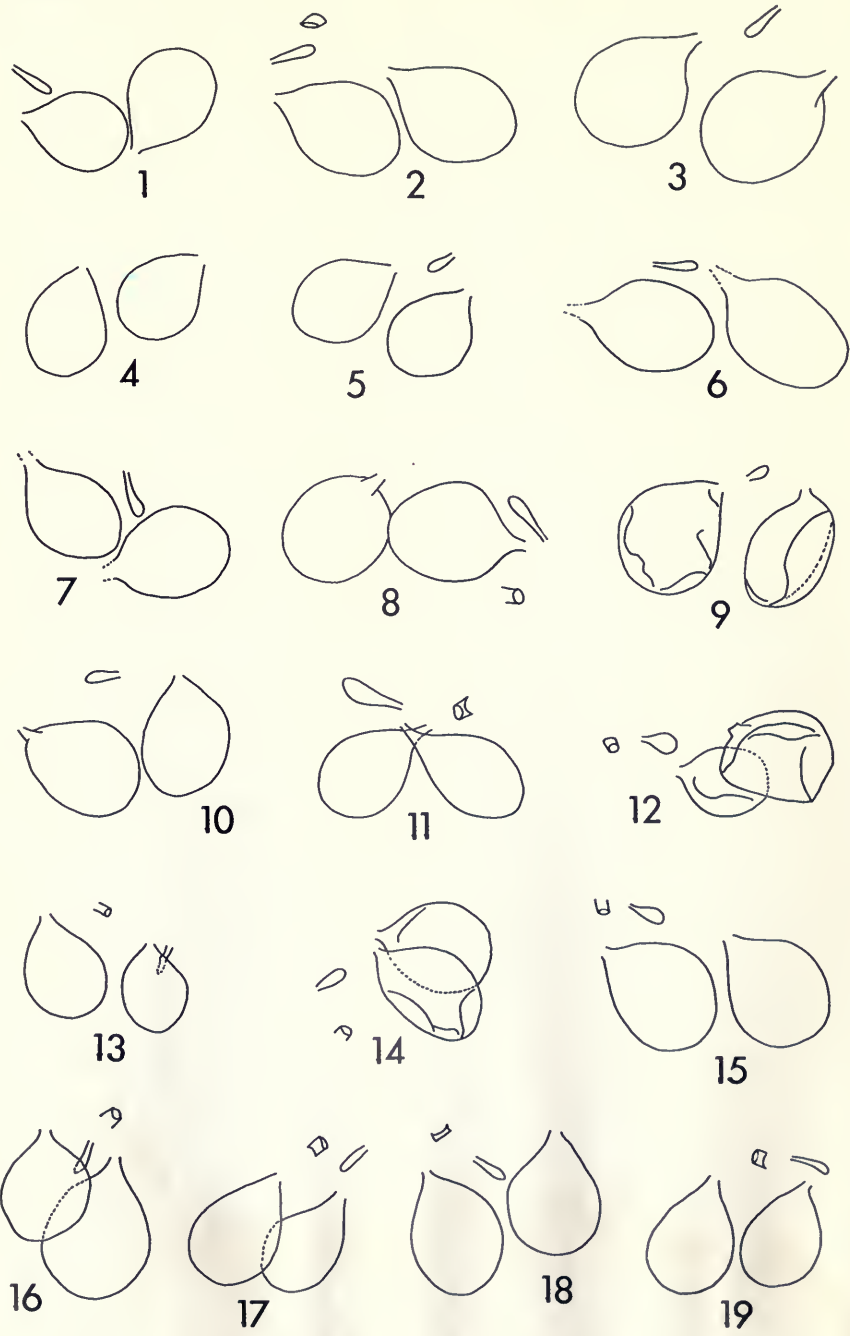
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| Fig. 12. <i>C. brevipalpis</i> , new sp. | Fig. 13. <i>C. nudipalpis</i> , new sp. |
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Subgenus *Hoffmania* Fox

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| Fig. 14. <i>C. bubalus</i> , new sp. | Fig. 15. <i>C. effusus</i> , new sp. |
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Subgenus *Culicoides* Latr.

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| Fig. 16. <i>C. assimilis</i> , new sp. | Fig. 18. <i>C. recurvus</i> , new sp. |
| Fig. 17. <i>C. hirtipennis</i> , new sp. | Fig. 19. <i>C. unicus</i> , new sp. |



MALE GENITALIA OF *CULICOIDES*

Subgenus *Oecacta* Poey

Fig. 1. *C. marginatus*, new sp.

Fig. 3. *C. wenzeli*, new sp.

Fig. 2. *C. palawanensis*, new sp.

Fig. 4. *C. pampangensis*, new sp.

Subgenus *Avaritia* Fox

Fig. 6. *C. radicitus*, new sp.

Subgenus *Culicoides* Latr.

Fig. 5. *C. hirtipennis*, new sp.

Fig. 7. *C. recurvus*, new sp.

Fig. 8. *C. unicus*, new sp.

